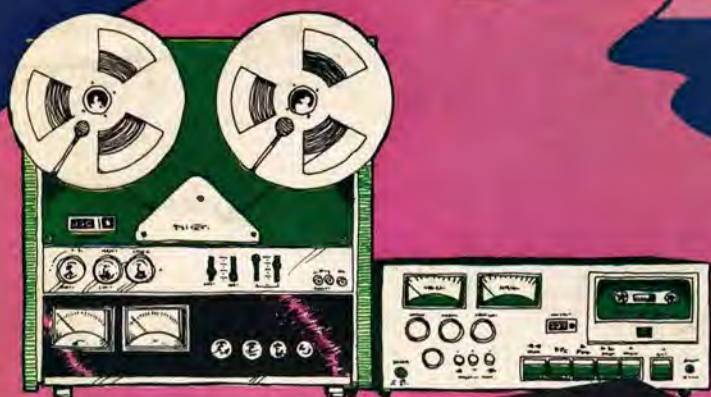


PE RATES THE NEW CASSETTE TAPES

Popular Electronics®

WORLD'S LARGEST SELLING ELECTRONICS MAGAZINE NOVEMBER 1977/\$1.25



HOW TO BUILD AN AUDIO COMPANDER



- Improves dynamic range of tapes
- Reduces noise level

How To Dress Up Your Projects

- Tips on making projects attractive

A Field-Disturbance Sensor for Security Systems

Add Voltage Regulation to Color Enlargers

Piracy On The Airwaves

TESTED THIS ISSUE: Dual 1245 Automatic Turntable

- Burwen DNF 1201A Noise Reduction System
- Mitsubisni DA-A15 Audio Power Amp and DA-P10 Preamp
- Realistic TRC-449 AM/SSB CB Mobile Transceiver
- North Star Floppy Disk



Introducing the mobile that can move you out of the world of the ordinary and into the world of the serious CB'er. The Cobra 138XLR Single Sideband. Sidebanding puts you in your own private world. A world where there's less congestion. More privacy. More time to talk.



It's all possible because instead of 40 channels you get your choice of 120 channels. Both AM and SSB. And instead of 4 watts of legal power you get 12 watts of legal power. So you get almost double the range of AM.

With the 138XLR Single Sideband there's less background noise and less interference. So there's cleaner, clearer reception. Because like all Cobras, the 138XLR SSB is engineered to punch through loud and clear. Even in crowded metropolitan areas.

And like all Cobras it comes equipped with such standard features as an easy-to-read LED channel indicator. Switchable noise blanking and limiting. An RF/signal strength meter. And Cobra's exclusive DynaMike gain control.

You'll find the 138XLR SSB wherever Cobras are sold. Which is almost everywhere. Because Cobra's got a nationwide network of dealers and Authorized Service Centers offering sales, installation, service and advice. So come on in. And move on up.



Punches through loud and clear.

Cobra Communications Products
DYNASCAN CORPORATION
6460 W. Cortland St., Chicago, Illinois 60635

Write for color brochure
EXPORTERS: Empire • Plainview, N.Y. • CANADA: Atlas Electronics • Toronto

CIRCLE NO. 8 ON FREE INFORMATION CARD

UPWARD MOBILITY.



Pocket CB

New integrated circuit technology and a major electronic breakthrough brings you the world's smallest citizens band transceiver.

Scientists have produced a personal communications system so small that it can easily fit in your pocket. It's called the PocketCom and it replaces larger units that cost considerably more.

MANY PERSONAL USES

An executive can now talk with anybody in his office, his factory or job site. The housewife can find her children at a busy shopping center. The motorist can signal for help in an emergency. The salesman, the construction foreman, the traveler, the sportsman, the hobbyist—everybody can use the PocketCom.

LONG RANGE COMMUNICATIONS

The PocketCom's range is limited only by its 100 milliwatt power and the number of metal objects between units or from a few blocks in the city to several miles on a lake. Its receiver is so sensitive, that signals several miles away can be picked up from stronger citizens band base or mobile stations.

VERY SIMPLE OPERATION

To use the PocketCom simply turn it on, extend the antenna, press a button to transmit, and release it to listen. And no FCC license is required to operate it. The PocketCom has two Channels—channel 14 and an optional second channel. To use the second channel, plug in one of the 22 other citizens band crystals and slide the channel selector to the second position. Crystals for the second channel cost \$7.95 and can only be ordered after receipt of your unit.



The PocketCom components are equivalent to 112 transistors whereas most comparable units contain only twelve.

A MAJOR BREAKTHROUGH

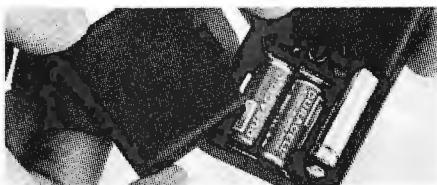
The PocketCom's small size results from a breakthrough in the solid state device that made the pocket calculator a reality. Scientists took 112 transistors, integrated them on a micro silicon wafer and produced the world's first transceiver linear integrated circuit. This major breakthrough not only reduced the size of radio components but improved their dependability and performance.

BEEP-TONE PAGING SYSTEM

You can page another PocketCom user, within close range, by simply pressing the PocketCom's call button which produces a beep tone on the other unit if it has been left in the standby mode. In the standby mode the unit is silent and can be kept on for weeks without draining the batteries.

SUPERIOR FEATURES

Just check the advanced PocketCom features now possible through this new circuit breakthrough: 1) Incoming signals are amplified several million times compared to only 100,000 times on comparable conventional systems. 2) Even with a 60 decibel difference in signal strength, the unit's automatic gain control will bring up each incoming signal to a maximum uniform level. 3) A high squelch sensitivity (0.7 microvolts) permits noiseless operation without squelching weak signals.



EXTRA LONG BATTERY LIFE

The PocketCom has a light-emitting diode low-battery indicator that tells you when your 'N' cell batteries require replacement. The integrated circuit requires such low power that the two batteries, with average use, will last weeks without running down.



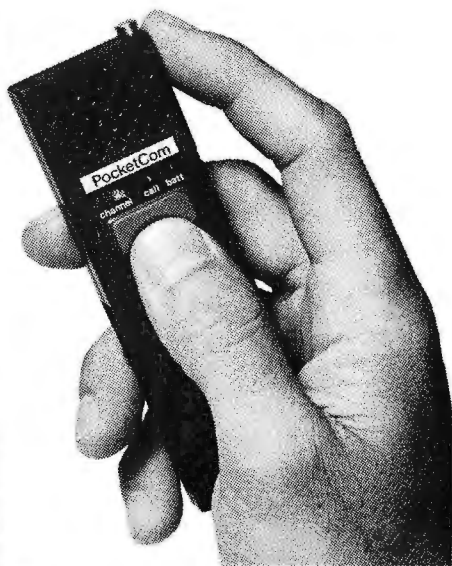
The PocketCom can be used as a pager, an intercom, a telephone or even a security device.

MULTIPLEX INTERCOM

Many businesses can use the PocketCom as a multiplex intercom. Each employee carries a unit tuned to a different channel. A citizens band base station with 23 channels is used to page each PocketCom. The results: an inexpensive and flexible multiplex intercom system for large construction sites, factories, offices, or farms.

NATIONAL SERVICE

The PocketCom is manufactured exclusively for JS&A and is the unit currently used on the hit TV show, Charlie's Angels. JS&A is America's largest supplier of space-age products—further assurance that your modest investment is well protected. The PocketCom should give you years of trouble-free service, however, should service ever be required, simply slip your 5 ounce PocketCom into its handy mailer and send it to our prompt national service-by-mail center.



The PocketCom measures approximately 3/4" x 1 1/2" x 5 1/2" and easily fits into your shirt pocket. The unit can be used as a personal communications link for business or pleasure.

GIVE IT A REAL WORKOUT

Remember the first time you saw a pocket calculator? It probably seemed unbelievable. The PocketCom may also seem unbelievable so we give you the opportunity to personally examine one without obligation. Order only two units on a trial basis. Then really test them. Test the range, the sensitivity, the convenience. Test them under your everyday conditions and compare the PocketCom with larger units.

After you are absolutely convinced that the PocketCom is indeed that advanced product breakthrough, order your additional units, crystals or accessories on a priority basis as one of our established customers. If, however, the PocketCom does not suit your particular requirements perfectly, then return your units within ten days after receipt for a prompt and courteous refund. You cannot lose. Here is your opportunity to test an advanced space-age product at absolutely no risk.

A COMPLETE PACKAGE

Each PocketCom comes complete with mercury batteries, high performance Channel 14 crystals for one channel, complete instructions, and a 90 day parts and labor warranty. To order by mail, simply mail your check for \$19.95 per unit (or \$39.95 for two) plus \$2.50 per order for postage, insurance and handling to the address shown below. (Illinois residents add 5% sales tax). But don't delay.

Personal communications is the future of communications. Join the revolution. Order your PocketComs at no obligation today.

NEW LOW PRICE!

Credit Card Buyers Call Toll-Free

\$19.95
per unit

*Sold originally for \$40 per unit.

JS&A NATIONAL SALES GROUP

Dept. PE One JS&A Plaza
Northbrook, Ill. 60062 (312) 564-9000
CALL TOLL-FREE... 800 323-6400
In Illinois call (312) 498-6900

©JS&A Group, Inc., 1977

IF YOU'RE NOT DESIGNING WITH A CSC PROTO-BOARD®, LOOK AT ALL YOU'RE MISSING.

Utility—Models are available with or without built-in regulated power supplies (fixed or adjustable).

Economy—Eliminate heat and mechanical damage to expensive parts. Save money by re-using components.

Versatility—Use with virtually all types of parts, including resistors, capacitors, transistors, DIP's, TO-5's, LED's, transformers, relays, pots, etc. Most plug in directly, in seconds.

Durability—All Proto-Board models are carefully constructed of premium materials, designed and tested for long, trouble-free service.

Expandability—Proto-Board units can be instantly inter-connected for greater capacity.

Visibility—All parts are instantly and easily visible, for quick circuit analysis and diagramming.

Speed—Assemble, test and modify circuits as fast as you can push in or pull out a lead. Save hours on every project.

Adaptability—Use in design, packaging, inspection, QC, etc. Works with most types of circuits, in many, many applications.

Flexibility—Use independently, or in conjunction with other accessories, such as scopes, counters, CSC Proto-Clip™ test equipment, etc. One Proto-Board unit can serve a thousand applications.

Accessibility—All parts are instantly and easily accessible, for quick signal tracing, circuit modifications, etc.

Variety—A wide variety of models are available with capacities ranging from 630 to 3060 solderless tie-points (6 to 32 14-pin DIP's), to fit every technical and budget requirement.



Whatever type of electronic circuits you work with, you can do more in less time with CSC's solderless Proto-Board systems. As fast and easy as pushing in or pulling out a lead, you can design, test and modify circuits at will. Components plug into rugged 5-point terminals, and jumpers, where needed, are lengths of #22 AWG solid wire. In the same time you took to read this ad, you could be well on your way to assembling a new circuit. For more information, pick up your phone and call your dealer—or order direct.

CSC PROTO-BOARD SOLDERLESS BREADBOARDS

MODEL NUMBER	NO. OF SOLDERLESS TIE-POINTS	IC CAPACITY (14-PIN DIP'S)	MANUFACTURER'S SUGG. LIST	OTHER FEATURES
PB-6	630	6	\$15.95	Kit — 10-minute assembly
PB-100	760	10	19.95	Kit — with larger capacity
PB-101	940	10	29.95	8 distribution buses, higher capacity
PB-102	1240	12	39.95	Large capacity, moderate price
PB-103	2250	24	59.95	Even larger capacity, only 2 ¢ per tie-point
PB-104	3060	32	79.95	Largest capacity, lowest price per tie-point
PB-203	2250	24	80.00	Built-in 1% regulated 5V, 1A low-ripple power supply
PB-203A	2250	24	129.95	As above plus separate ½-amp +15V and -15V internally adjustable regulated power supplies

See your CSC dealer or call 203-624-3103 (East Coast) or 415-421-8872 (West Coast) 9 AM to 5 PM local time. Major credit cards accepted. Add \$2.50 for shipping and handling in the U.S. and Canada on direct orders of \$50.00 or less; \$3.00 for orders over \$50.00. On all foreign orders add 15% to cover shipping and handling.

CONTINENTAL SPECIALTIES CORPORATION



44 Kendall Street, Box 1942, New Haven, CT 06509
203-624-3103 TWX 710-465-1227
West Coast: 351 California St., San Francisco, CA 94104
415-421-8872 TWX 910-372-7992
MEXICO: ELPRO, S.A., Mexico City 5-23-30-04
CANADA: Len Finkler Ltd., Ontario

© 1976 Continental Specialties Corp.
Prices and specifications subject to change without notice.

CIRCLE NO. 13 ON FREE INFORMATION CARD

POPULAR ELECTRONICS

Coming Next Month

SPECIAL FOCUS ON HOME COMPUTERS, INCLUDING:

- Home Computer Buying Guidelines
- How to Use Existing House Wiring for Computer Control Applications
- Wire-Wrapping Techniques for Computer Hobbyists
- Computer Stores—A New Retailing Phenomenon

NOW YOU CAN USE SOLAR ENERGY TO POWER YOUR PROJECTS

HOW FM TUNERS WORK

ANNUAL EDITORIAL INDEX FOR 1977

POPULAR ELECTRONICS, November 1977, Volume 12, Number 5. Published monthly at One Park Avenue, New York, NY 10016. One year subscription rate for U.S. and Possessions, \$12.00; Canada, \$15.00; all other countries, \$17.00 (cash orders only, payable in U.S. currency). Second Class postage paid at New York, NY and at additional mailing offices. Authorized as second class mail by the Post Office Department, Ottawa, Canada, and for payment of postage in cash.

POPULAR ELECTRONICS including ELECTRONICS WORLD, Trade Mark Registered. Indexed in the Reader's Guide to Periodical Literature.

COPYRIGHT © 1977 BY ZIFF-DAVIS PUBLISHING COMPANY. ALL RIGHTS RESERVED.

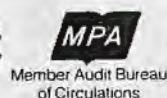
Ziff-Davis also publishes Boating, Car and Driver, Cycle, Flying, Modern Bride, Popular Photography, Skiing and Stereo Review.

Material in this publication may not be reproduced in any form without permission. Requests for permission should be directed to Jerry Schneider, Rights and Permissions, Ziff-Davis Publishing Co., One Park Ave., New York, NY 10016.

Editorial correspondence: POPULAR ELECTRONICS, 1 Park Ave., New York, NY 10016. Editorial contributions must be accompanied by return postage and will be handled with reasonable care; however, publisher assumes no responsibility for return or safety of manuscripts, art work, or models.

Forms 3579 and all subscription correspondence: POPULAR ELECTRONICS, Circulation Dept., P.O. Box 2774, Boulder, CO 80302. Please allow at least eight weeks for change of address. Include your old address, enclosing, if possible, an address label from a recent issue.

The publisher has no knowledge of any proprietary rights which will be violated by the making or using of any items disclosed in this issue.



Feature Articles

- 32 **DYNAMIC CROSSTALK** / *Julian Hirsch*
- 47 **SELECTING THE BEST CASSETTE TAPE FOR YOUR RECORDING NEEDS** / *Craig Stark*
- 56 **PIRACY ON THE AIRWAVES** / *Harry L. Helms*
The current state of illegal broadcasting.
- 65 **PE COMICS CORNER** / *Frank Bolle*
- 92 **CLIPPER CIRCUIT QUIZ** / *Robert P. Balin*
- 94 **ENGLISH-LANGUAGE SHORTWAVE BROADCASTS FOR NOV. THRU FEB.** / *Richard E. Wood*

Construction Articles

- 43 **BUILD AN AUDIO COMPANDER** / *John Roberts*
Provides greater dynamic range and reduces noise.
- 53 **HOW TO DRESS UP YOUR PROJECTS** / *Robert DeVoe*
Tips on making your home-made equipment look professional.
- 58 **MAKING DIGITAL ELECTRONIC CLOCKS IMMUNE TO AC FLICKER** / *Andrew Fraser*
- 60 **BUILD A FIELD DISTURBANCE SENSOR FOR SECURITY** / *Ken Powell*
Inexpensive alarm device detects light changes in its field of view.
- 63 **ADD VOLTAGE REGULATION TO A COLOR PHOTO ENLARGER** / *D. W. Schneider*

Columns

- 22 **STEREO SCENE** / *Ralph Hodges*
New Tests for Loudspeakers.
- 67 **SOLID STATE** / *Lou Garner*
Back to the (Circuit) Mines.
- 77 **EXPERIMENTER'S CORNER** / *Forrest M. Mims*
Programmable Read-Only Memories.
- 84 **HOBBY SCENE Q&A** / *John McVeigh*
- 88 **COMPUTER BITS** / *Hai Chamberlin*
High-Level Languages.
- 90 **CB SCENE** / *Walter Salm*
The Forgotten CB Service.
- 93 **DX LISTENING** / *Glenn Hauser*
Shortwave Programs.

Julian Hirsch Audio Reports

- 33 **MITSUBISHI MODEL DA-P10 PREAMPLIFIER AND MODEL DA-A15 BASIC POWER AMPLIFIER**
- 37 **DUAL MODEL 1245 AUTOMATIC TURNTABLE**
- 39 **BURWEN MODEL DNF 1201A NOISE REDUCER**

Electronic Product Test Reports

- 85 **REALISTIC MODEL TRC-449 MOBILE AM/SSB CB TRANSCEIVER**
- 86 **NORTH STAR MODEL MDS-A MICRO DISK SYSTEM**

Departments

- 4 **EDITORIAL** / *Art Salsberg*
Sniffing Out Smokeys.
- 6 **LETTERS**
- 12 **OUT OF TUNE**
"Build a Digital Camera Shutter Timer" (August 1977);
"Build 'Cabonga' Part 2" (September 1977)
- 14 **NEW PRODUCTS**
- 18 **NEW LITERATURE**
- 98 **ELECTRONICS LIBRARY**
- 116 **OPERATION ASSIST**
- 124 **NEWS HIGHLIGHTS**

Popular Electronics®

JOSEPH E. MESICS
Publisher

ARTHUR P. SALSBERG
Editorial Director

LESLIE SOLOMON
Technical Editor

JOHN R. RIGGS
Managing Editor

IVAN BERGER
Senior Editor

ALEXANDER W. BURAWA
Features Editor

EDWARD I. BUXBAUM
Art Director

JOHN McVEIGH
Associate Editor

ANDRE DUZANT
Technical Illustrator

CLAUDIA TAFARO
Production Editor

DORIS A. MATTHEWS
Editorial Assistant

Contributing Editors
Hal Chamberlin, Lou Garner, Glenn Hauser
Julian Hirsch, Ralph Hodges, Forrest Mims
Ray Newhall, Wilfred Scherer

JOSEPH E. HALLORAN
Advertising Director

JOHN J. CORTON
Advertising Sales

LINDA BLUM
Advertising Service Manager

PEGI McENEANEY
Executive Assistant

EDGAR W. HOPPER
Publishing Director

ZIFF-DAVIS PUBLISHING COMPANY
Editorial and Executive Offices
One Park Avenue New York, New York 10016
212-725-3500

Hershel B. Sarbin, President
Philip Korsant, Executive Vice President
Furman Hebb, Executive Vice President
John R. Emery, Sr. Vice President, Finance and Treasurer
Philip T. Helfmann, Sr. Vice President
Edward D. Muhlfeld, Sr. Vice President, Sports Division
Philip Sine, Sr. Vice President
Frank Pomerantz, Vice President, Creative Services
Arthur W. Butzow, Vice President, Production
Lawrence Sporn, Vice President, Circulation
George Morrissey, Vice President
Sydney H. Rogers, Vice President
Sidney Holtz, Vice President
Albert S. Traina, Vice President
Paul H. Chook, Vice President
Edgar W. Hopper, Vice President
Robert N. Baxter, Jr., Vice President
Charles B. Seton, Secretary

William Ziff, Chairman
W. Bradford Briggs, Vice Chairman

Midwestern Office
The Patis Group, 4761 West Touhy Ave.
Lincolnwood, Illinois 60466, 312-679-1100
Thomas Hockney, Michael Neri, Gerald E. Wolfe
Western Office
9025 Wilshire Boulevard, Beverly Hills, CA 90211
213-273-8050; BRadshaw 2-1161
Western Advertising Manager: Bud Dean
Japan: James Yagi
Oji Palace Aoyama, 5-25, Minami Aoyama
6 Chome, Minato-Ku, Tokyo 407-1930/6821,
582-2851



Editorial

SNIFFING OUT SMOKEYS

Great Britain zapped the Luftwaffe through the use of radar during World War III! In the afteryears, highway police departments adopted the same principle to catch speeding motorists—with better than a 99 percent conviction rate on radar evidence. This was countered, with typical American ingenuity, by radar detectors for the motorist to spot radar signals before they reached him and had time to return to the police for readout. Thus, he was warned to slow down in advance.

As the ownership of these detectors increased (now reported to be more than 500,000), the police increased their radar setups tenfold—to some 50,000 throughout the nation. Furthermore, whereas most police radar uses the X band (10.52 GHz), there is growing use of K-band radar (24.125 GHz), now said to constitute about 5 percent of the total in speed-enforcement work. Radar-detector manufacturers countered with K-band detectors and combined X- and K-band detectors. The police, in turn, introduced radar that's tuned slightly outside the standard bands so that the detectors can't give the alarm. This was followed by the introduction of radar detectors that scan from 9 to 25 GHz (FCC police frequency allocation is actually 9.445 to 24.445 GHz). With all of these moves and counter-moves, it's now the police departments' turn to tip the balance.

Now if this little game isn't sufficient to make you gasp, consider state laws concerning the use of radar detectors by motorists. Until recently, the use of detectors was illegal in a handful of states, users being subject to fines and/or equipment confiscation. In some instances, there were no laws against use of radar detectors, but state police issued tickets for them anyway. In the past year, nine states voted down bills prohibiting radar detectors. This was not truly surprising since the air-waves are "free" for listeners. Besides, electromagnetic communications is the reserve of the Federal Government, not the states. Nonetheless, there is still one state with an anti-radar-detector law—Virginia. (The state's house and senate voted to repeal it recently, but the governor vetoed the repeal.) Of course, all this doesn't mean that you won't be ticketed in a state other than Virginia. There might be some local statutes that indicate it's illegal to pick up police signals—though they might not hold up in court.

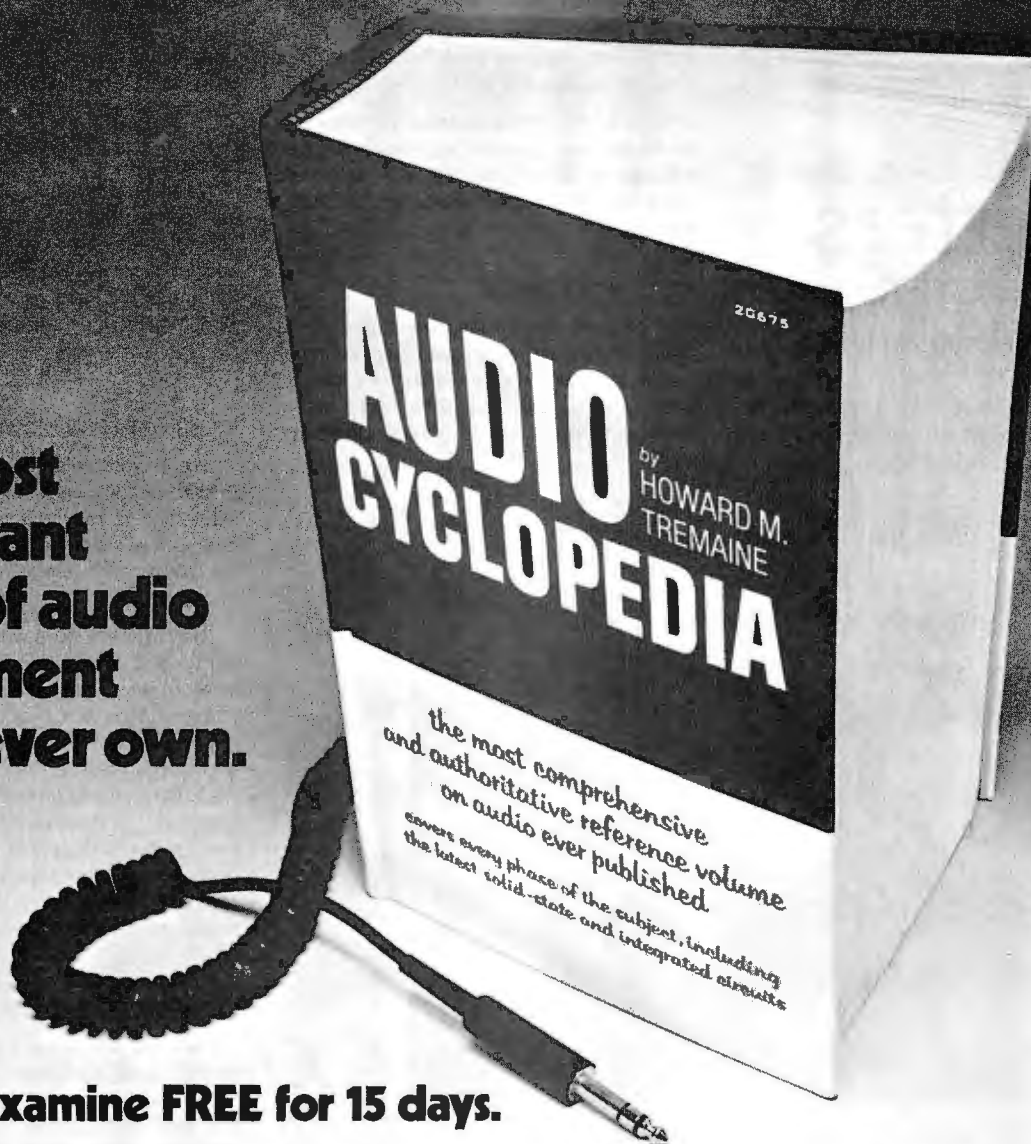
Therefore, the main consideration regarding the use of radar detectors is now one of morality. Is it morally correct to outfox the law (for the purposes of exceeding the speed limit)? That's just what the speeding motorist is doing when he uses a radar detector. He's set up so that he can be alerted to a police radar net lurking ahead, enabling him to slow down before he is caught. Can you think of another reason for having a radar detector mounted in a car?

Proponents of radar detectors can whip up some other justifications, of course. One argument is that the system reminds the driver that he is going too fast and he slows down. Other "pro" views reflect the feeling that no one should rule us: we have highly efficient highway networks so why not take advantage of them? . . . The police are spending too much time on an unimportant matter when other pressing problems are largely ignored . . . An unpopular law is being enforced, so let the people's will reign . . . And so on.

The 55-MPH speed limit was established to decrease the amount of gasoline used, thereby saving a much-needed resource. An important byproduct has been the reduction of automobile fatalities on the highways. Furthermore, we all, I believe, have a social responsibility to obey our laws in order to strengthen our society. If an individual (or group of people) objects to a law, there are legal ways to eliminate it. In fact, that's just what has been done with radar-detector prohibitions! They've been virtually overcome legally, though I must admit that I find this broad interpretation of the Communications Act of 1934 (U.S.C. Title 47) unsettling.

Art Salsberg

**The most
important
piece of audio
equipment
you'll ever own.**



Yours to examine FREE for 15 days.

**25 FACT-FILLED CHAPTERS
ARRANGED IN "EASY-TO-FIND"
QUESTION AND ANSWER FORM**

- Basic Principles of Sound
- Acoustics, Studio techniques, and Equipment
- Constant-Speed Devices, Motors, and Generators
- Microphones
- Attenuators
- Equalizers
- Wave Filters
- Transformers and Coils
- Sound Mixers
- VU and Volume Indicator Meters
- Vacuum Tubes, Transistors, and Diodes
- Audio Amplifiers
- Disc Recording
- Cutting Heads
- Recording and Reproducing Stylis
- Pickups
- Magnetic Recording
- Optical Film Recording
- Motion Picture Projection Equipment
- Loudspeakers, Enclosures, Headphones, and Hearing Aids
- Power Supplies
- Test Equipment
- Audio-Frequency Measurements
- Installation Techniques
- General Information, Charts and Tables

Be our guest. Examine the AUDIO CYCLOPEDIA free for 15 days. You'll find out why it is considered the most comprehensive and authoritative book ever written on the subject. And you'll get a FREE \$3.50 bonus book to keep no matter what!

The AUDIO CYCLOPEDIA is literally a one-book audio library. It has long been considered "the bible" by amateur stereo buffs as well as professional technicians. That's why you'll find it in constant use not only in home workshops and at stereo centers, but also in recording studios, broadcast booths and concert halls.

This giant reference book is over 3" thick,

and packed with 1,757 illustrated pages. It features 3,645 questions and answers and a 50 page "instant-find" index for subject identification. It is truly the big one in audio electronics and it puts all the information you'll ever need right at your fingertips, chapter by chapter.

Send for the AUDIO CYCLOPEDIA today. If you don't agree that it's the most important piece of audio equipment you own, just return it within 15 days. You won't owe a cent. And no matter what you decide, you'll get a free \$3.50 copy of *The ABC's of Tape Recording* to keep just for mailing the coupon.

**FREE-BOOK
FREE-TRIAL COUPON**



Save postage & handling costs. Full payment enclosed (plus tax where applicable). 15-day return privilege still applies.

Yes, please rush me the AUDIO CYCLOPEDIA (#21455) for my free trial. I understand if not completely satisfied, I may return it within 15 days, and owe nothing. Otherwise, it's mine to keep for only \$34.00 plus postage and handling and local taxes (where applicable).

And, whatever I decide, a copy of "The ABC's of Tape Recording" (valued at \$3.50) is mine free!

Name

Address

City

State Zip



Mail to Audel
4300 W. 62nd Street
Indianapolis, Indiana 46206
A Division of Howard W. Sams & Co., Inc.

EB35A

Letters

GETTING MANUFACTURERS' INFO

In the August 1977 Solid State column, it was stated that a lot of good ideas and manufacturers' information can be obtained from

the pamphlets published by manufacturers. What I would like to know is how one goes about receiving these pamphlets. —Kenneth J. Goodnow, Tucson, AZ

Each of the manufacturers mentioned in the Solid State column is accompanied by an address to which you can write to obtain more information (pamphlets, specifications sheets, etc.).

MOS STATIC DAMAGE

In "How to Avoid Static Damage to MOS Devices" (August 1977), a number of companies that market products for safe handling of MOS devices were mentioned. We noted, however, that Walter G. Legge Company,

Inc. (101 Park Avenue, New York, NY 10017), one of the oldest firms in this field, was not mentioned. We manufacture very sophisticated "Personnel Grounding Devices." All are insulated and have resistors to protect both the MOS devices and the personnel who handle them.

We also make conductive coatings in various colors that can be used on benches, floors, containers, etc. This product costs about 5¢ per square foot to apply and eliminates tripping hazards from mats and trailing wires. —Ralph C. Ohibach, Walter H. Legge Co., Inc., New York, NY.

USING LIFT-IT ON GRAPH PAPER

I read with interest "New 'No Camera' Printed Circuit Board Methods" (May 1977). I would like to know whether or not the Lift-It emulsion will remove any of the ruled lines on the graph paper I am using. —Len Buchanan, Scarborough, Ontario, Canada

The Lift-It emulsion works best when lifting the etching and drilling guides for pc boards from printed magazine pages. However, if you use it on home-made guides on graph paper, be aware that the paper must not have a glazed surface or be of "vellum" material. Also, the ink used must be printer's or similar type. You need not worry about lifting the grid lines of the graph paper if the lines are relatively fine and light blue or light green in color. Neither of these colors is opaque to the ultraviolet light used when making exposures.

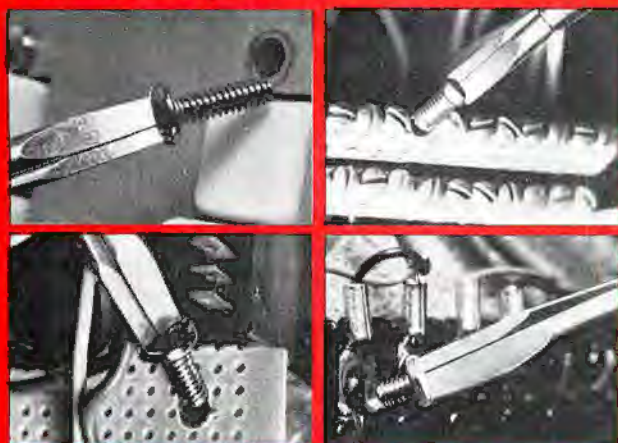
OPTIMIZING PERFORMANCE

I noticed with great interest the "Portable 60-Hz Clock Oscillator" article in the July 1977 issue. I have design experience using the MM5369 IC used in this application at 3.58 MHz and have found the IC to be unstable at 5 volts V_{CC} . We found, after consulting the manufacturer, that the MM5369 is specified for a minimum oscillating frequency of 2 MHz at 6 volts. I recommend applying at least 8 volts for proper operation at 3.58 MHz, rather than the 3 to 15 volts specified in the article. —Stan Apel, Torpey Controls & Engineering Ltd., Toronto, Canada.

I would like to pass on a few hints for adjusting the MM5369 for proper operation. Start off by setting the trimmer to the middle of its range, rather than matching the divided crystal frequency to the 60-Hz power line. While the ac line is very accurate over a 24-hour period, it is considerably less accurate over shorter periods of time. If a frequency counter is used to calibrate the circuit, be aware that connecting it to pin 7 of the IC will yield a slight frequency shift, even though the output is buffered. You do not really want the 3.579545 MHz marked on the crystal; you want either 3.579600 MHz for early production MM5369's or 3.579540 MHz for the current MM5369's.

The Parts List is misleading. Capacitors C2 and C3 must be relatively stable. Use NPO
(Continued on page 12)

Use Quick-Wedge to wire in panelights, rackmount components, connect a barrier block, fasten circuit modules.



They do all that ordinary screwdrivers do, PLUS they hold and start the screw



17 sizes

QUICK-WEDGE
SCREW-HOLDING SCREWDRIVER

Unconditionally guaranteed. BUY A SET TODAY
See your dealer or write to:
Kedman Company, P.O. Box 25667,
Salt Lake City, Utah 84125

© 1977

CIRCLE NO. 35 ON FREE INFORMATION CARD

Bearcat[®] 210 Scanner

\$289.



The Bearcat 210 super synthesized receiver scans and searches over 16,000 different frequencies without expensive crystals. The Bearcat 210 covers 32-50, 146-174 & 416-512 Mhz., and has AC/DC operation. Save over \$60.00 now by ordering on our 24 hour toll-free credit card order line 800-521-4414. In Michigan and outside the U.S. call 313-994-4441. Add \$5.00 for shipping in the U.S. or \$9.00 for air UPS to the west coast. Charge cards or money orders only. Foreign orders invited.

COMMUNICATIONS ELECTRONICS
P.O. BOX 1002 DEPT.
ANN ARBOR, MICHIGAN 48106



709-294 p.—Modern Guide to Digital Logic: Processors, Memories & Interfaces (\$9.95)

SMALL APPLIANCE REPAIR GUIDE-Vol. 2
by Leo E. Sands

715/745-405 p.—TWO BOOKS: Small Appliance Repair Guide—Vol. 2 & The Home Appliance Clinic: Controls, Cycle Timers, Wiring & Repair (\$15.90)

BUILD YOUR OWN WORKING ROBOT
BY DAVID L. BERGMAN

841-238 p.—Build Your Own Working Robot (\$8.95)

THE HOME APPLIANCE CLINIC:
Controls, Cycle Timers, Wiring & Repair

797-160 p.—Electric Motor Test & Repair (\$6.95)

ELECTRIC MOTOR TEST & REPAIR

876-352 p.—Color TV Case Histories Illustrated: Photo Guide to Troubles & Cures—Vol. 2 (\$10.95)

BASIC DIGITAL ELECTRONICS
A Practical Approach

728-210 p.—Basic Digital Electronics: Understanding Number Systems, Boolean Algebra & Logic Circuits (\$7.95)

652-602 p.—2nd Class FCC Encyclopedia—Complete Study Guide to the Commercial Radiotelephone Exam (\$10.95)

An Extraordinary Offer to introduce you to the benefits of Membership in

ELECTRONICS BOOK CLUB

take any **3** of these unique electronics books (value to \$47.75) for only **99¢** each

with a Trial Membership in the Book Club that guarantees to save you 25% to 75% on a wide selection of electronics books

All two-book sets count as only one of your three Selections.

934-288 p.—Photo Guide to AM/FM Stereo Repair (\$9.95)

101-416 p.—Electronic Circuit Design Handbook—4th Edition (\$17.95)

796-196 p.—MOSFET Circuits Guidebook—with 100 Tested Projects (\$7.95)

MOSFET CIRCUITS GUIDEBOOK
with 100 Tested Projects
By Ralph R. Towner

Photo Guide to AM/FM Stereo Repair

modern applications of linear IC's

708-276 p.—Modern Applications of Linear IC's (\$12.95)

ELECTRONIC CIRCUIT DESIGN HANDBOOK

DICTIONARY OF ELECTRONICS

300-420 p.—Dictionary of Electronics (\$9.95)

Integrated Circuits Guidebook

771-196 p.—Integrated Circuits Guidebook (\$8.95)

THE "COMPUTATOR"
Building Super Calculators & Microcomputer Hardware With Calculator Chips

975-322 p.—The "Computator" Book—Building Super Calculators & Microcomputer Hardware With Calculator Chips (\$10.95)

Experimenting With Electronic Music

666-180 p.—Experimenting With Electronic Music (\$7.95)

RF & Digital Test Equipment You Can Build

729-252 p.—RF & Digital Test Equipment You Can Build (\$8.95)

Programming Microprocessors

985-280 p.—Programming Microprocessors (\$9.95)

CBer's Handbook of Hobby Projects

790/868-308 p.—TWO BOOKS: 21 Simple Transistor Radios You Can Build—From Crystal Sets to Superhets & CBER's Handbook of Simple Hobby Projects (\$13.90)

May we send you your choice of these 3 practical, time-and-money-saving books as part of an unusual offer of a Trial Membership in Electronics Book Club?

Here are quality hardbound volumes, each especially designed to help you increase your know-how, earning power, and enjoyment of electronics. Whatever your interest in electronics, you'll find Electronics Book Club offers practical, quality books that you can put to immediate use and benefit.

This extraordinary offer is intended to prove to you, through your own experience, that these very real advantages can be yours...that it is possible to keep up with the literature published in your areas of interest, and to save substantially while so doing. As part of your Trial Membership, you need purchase as few as four books during the coming 12 months. You would probably buy at least this many anyway...without the substantial savings offered through Club Membership.

To start your Membership on these attractive terms, simply fill out and mail the coupon today. You will receive the 3 books of your choice for 10-day inspection. YOU NEED SEND NO MONEY! If you are not delighted, return the books within 10 days and your Trial Membership will be cancelled without cost or obligation.

ELECTRONICS BOOK CLUB, Blue Ridge Summit, Pa. 17214

Facts About Club Membership

- The 3 introductory books of your choice carry publishers' retail prices of up to \$47.75. They are yours for only 99¢ each (plus postage and handling) with your Trial Membership.
- You will receive the Club News, describing the current Selection, Alternates and other offerings, every 4 weeks (13 times a year).
- If you want the Selection, do nothing, it will be sent to you automatically. If you do not wish to receive the Selection, or if you want to order one of the many Alternates offered, you simply give instructions on the reply form (and in the envelope) provided, and return it to us by the date specified. This date allows you at least 10 days in which to return the form. If, because of late mail delivery, you do not have 10 days to make a decision and so receive an unwanted Selection, you may return it at Club expense.
- Personal service for your account—no computers used!
- To complete your Trial Membership, you need buy only four additional monthly selections or alternates during the next 12 months. You may cancel your Membership any time after you purchase these four books.
- All books—including the Introductory Offer—are fully returnable after 10 days if you're not completely satisfied.
- All books are offered at low Member prices, plus a small postage and handling charge. Prepaid orders shipped postpaid.
- **Continuing Bonus** If you continue after this Trial Membership, you will earn a Dividend Certificate for every book you purchase. Three Certificates, plus payment of the nominal sum of \$1.99, will entitle you to a valuable Book Dividend of your choice which you may choose from a list provided Members.

ELECTRONICS BOOK CLUB

Blue Ridge Summit, Pa. 17214

Please open my Trial Membership in ELECTRONICS BOOK CLUB and send me the 3 books circled below. I understand the cost of the books I have selected is only 99¢ each, plus a small shipping charge. If not delighted, I may return the books within 10 days and owe nothing, and have my Trial Membership cancelled. I agree to purchase at least four additional books during the next 12 months, after which I may cancel my membership at any time.

T-97	101	300	652	666	708
	709	715/745	728	729	771
790/868	796	841	876	934	975 985

Name _____ Phone _____

Address _____

City _____

State _____ Zip _____

(Valid for new Members only. Foreign and Canada add 10%) PE-117

Only NRI

25" designed-

DIAGONAL

Color TV

Quadraphonic



Two home training schools give you a hobby-kit Color TV to assemble. Two others give you a commercial set right off the shelf. Neither was designed to teach you how to repair Color TV's. Only NRI invested the time and money to design equipment with learning in mind!

No other home training school gives you both a solid state Color TV and SQ™ Quadraphonic Receiver complete with four speakers . . . all in one course. In fact, to even match this kind of thorough training at another school, you'd have to take an extra

course costing hundreds of dollars more. And only NRI courses in Color TV/Audio servicing let you learn on equipment designed specifically for training.

It's the only way you can (1) get the feel of typical commercial circuitry, (2) learn bench techniques while building complete units from the "ground" up, (3) perform over 35 "in-set" experiments during construction, and (4) end up with a 25" diagonal solid state Color TV with cabinet and a 4-channel Audio Center.

NRI passes the savings on to you

NRI engineering eliminates the cost of buying from an outside source. We pay no salesman's commission. Students are enrolled by mail only. The savings are passed on to you in the form of low tuition fees, extras like the TV's console cabinet and the Quadraphonic System; professional test instruments like a 5" triggered sweep oscilloscope, CMOS digital frequency counter, and integrated circuit Color TV pattern generator. You can pay hundreds of dollars more for similar courses and not

™ Trademark of CBS, Inc.

gives you this for-learning ...plus complete Audio Center.

get a nickel's worth more in training and equipment.

More know-how per dollar

It all boils down to the quality of training you get for your money. In our 62-year history, more than a million students have come to NRI and we're fully approved for career training under the G.I. Bill. We know the right way to make home training pay dividends for you.

Some of those "right" things are bite-size lessons to ease understanding and speed learning . . . personal consultation, and prompt grading of all tests . . . a full-time staff of engineer/instructors to help if you need it . . . the right kind of kits and experiments to give you hands-on training . . . and fully professional programs oriented to full or part-time career needs.

Also CB, Computer, & Other Courses

NRI offers not one, but five TV/Audio servicing courses so you can tailor your training to your budget. Or you can study other opportunity fields like Digital Computer Electronics, Citizens Band Radio, Communications, Aircraft or



Marine Electronics,
Mobile Radio and more.
Send for your free catalog and
see for yourself that no one gives you
more training and equipment for your
dollar. There's no obligation and no
salesman will call.

If card is missing, write to:



NRI SCHOOLS
McGraw-Hill Continuing
Education Center
3939 Wisconsin Avenue,
Washington, D.C. 20016

In the Black II



Performance, beauty, quality — three attributes that have always been the hallmarks of SAE products. SAE systems in the past have had them, this system's predecessor had them, and the new In The Black system has them and much more.

The 2900 Parametric Preamplifier offers our new flexible parametric tone control system, full dubbing and tape EQ. New phono and line circuitry results in unparalleled clarity and definition with distortion of less than 0.01% THD & IM.

The 2200 Stereo Power Amplifier with fully complementary circuitry delivers 100 Watts RMS per channel from 20-20K at less than 0.05% Total Harmonic Distortion, from 250mW to full rated power.

The 8000 Digital FM Tuner has linear phase filters, phase-lock multiplex, and of course, our famous digital readout tuning indicator system.

Combine these products together and you have a system that ensures superior performance in all areas, excellent control flexibility, and the sonic quality that is typically SAE.

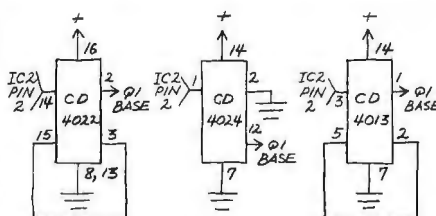
SAE
Scientific Audio Electronics, Inc.
P.O. Box 60271 Terminal Annex, Los Angeles, CA 90060

LETTERS (Continued from page 6)

ceramic, mica, or polystyrene. Anything else will cause the frequency to drift with temperature changes. Resistor *R1* need not be rated at 20 megohms and 5% tolerance; any resistor value between 5 megohms and 500 megohms will work fine. Also, *C1* can be an ordinary 0.1- μ F ceramic or 10- μ F electrolytic capacitor instead of the expensive tantalum capacitor specified. Finally, we recommend at least 5 volts V_{CC} , with 9 volts appearing to be the optimum. Going as high as 15 volts can sometimes cause the crystal to oscillate on its third harmonic. —Clive Tobin, Tobin Cinema Systems, Seattle, WA.

ADDENDUM TO "READER CIRCUIT"

Many thanks for publishing my circuit for the calculation/stopwatch adapter in the April 1977 Solid State column. I note, however, that I omitted the connection from pin 13 of *IC2* to ground. This connection must be made to enable the chip. Also, the debounce circuitry in some calculators apparently does not respond properly to the commands given at the 10-Hz rate. The solution to this is to put another divider into the circuit so that the switch operates at a 5-Hz rate. Some circuits that can be used to accomplish this are shown below. Using these circuits, it may be



necessary to experiment with the value of *C4*, which determines the time the switch remains closed; I found 0.033 μ F to work best on one of my slow calculators. With the slower rate, naturally, the calculator should be keyed \cdot , 2, +, but the rest of the operation is the same. —Will Hobbs, Eugene, OR

GREATER VISIBILITY

Many thanks for the "Morse-A-Letter" (January 1977). When I built mine, I incorporated a matrix of $\frac{1}{4}$ " (6.35-mm) high-brightness discrete LED's for the seven-segment displays specified. My 5 \times 7 matrix measures approximately 3" \times 2" (7.6 \times 5.1 cm), which is much easier to read and excellent to use in code classes. My display can be read from 20' (6.1 m) away. —Martin J. Forrest, WA6EWC/WB6VPC, San Jose, CA.

GETTING STARTED IN ATV

Your "TV For Radio Amateurs" Editorial in the June 1977 issue interested me enough to want to know more about Amateur TV. Now I would like to know how one goes about finding out if there is an ATV group operating in

this area. Also, is there a magazine published for or by the Amateur TV community? —Melvin D. Carpenter, Virginia Beach, VA.

To locate an ATV group operating in your area, contact the ARRL (American Radio Relay League, Inc., Newington, CT 06111). There is also a bimonthly magazine, "Amateur Television Magazine," available for \$4.00 per year by subscription. (Write: "AS: Amateur Television Magazine," P.O. Box 128, Whitmore Lake, MI 48189.)

IT WORKS!

After reading "Zap New Life Into Ni-Cd Batteries" (July 1977), I decided to give the procedure outlined a try. My grass trimmer's battery had given out just as described in the article. So, I had a good test for the zapping procedure. It works! —Charles DeVoe, Painted Post, NY

WANTS MORE SWL ARTICLES

I am writing this letter to express my pleasure with POPULAR ELECTRONICS, particularly for the seasonal articles on SWL'ing by Glenn Hauser and Dr. Richard E. Wood. I urge you to devote more space to shortwave listening articles; PE is one of two publications that feature regular SWL articles, but it is a long time between such articles. —David Jerard Duke, WDX5JD, El Paso, TX

The column will be increased to six times a year, as will Amateur Radio.

OPENING STATEMENT CONTRADICTED

The opening statement of "Battery Charge Monitor" by W.J. Prudhomme (June 1977) is contradicted by information contained in "Characteristics and Uses of Nickel-Cadmium Batteries," third edition, by the International Nickel Co., Inc. I have, however, seen a number of examples of the failure with shorting described in the article. On the other hand, it is sometimes recommended that the "memory" phenomenon sometimes observed in NiCd cells that are repeatedly charged after only partial discharge can be overcome by complete discharge, then recharging. —Milford S. Brown, Albany, CA.

Out of Tune

In "Build a Digital Camera Shutter Timer" (August 1977), *DIS1* through *DIS5*, DL-04 seven-segment LED displays, are common-cathode types, not common-anode as described in the Parts List.

In "Build 'Cabonga' Part 2" (September 1977), Fig. 6, the anode of *D4* and the cathode of *D2* should not be grounded, but should be connected only to the secondary of *T1*, as in Fig. 7, the guides for the Combiner/Power Pack pc board.

LCD Watch Breakthrough...

MICRO-ALARM

Beep!

Beep!



a 6-digit 6 function LCD Alarm Watch for only \$69.95!

At last, a constant readout (no buttons to push) precision quartz electronic watch with a built-in 24 hour alarm system.

A quiet revolution has been taking place in the electronic watch industry during the last few years. Push-button LED's are being replaced with continuous-display LCD watches; 4-digit displays are being replaced by 6-digit readouts. This year there will be many such LCD watches available.

However, Winthrop-Rogers prides itself on offering not only the most technologically-perfect products available, but also on introducing the most technologically-advanced products on the electronic market before they are readily available. Therefore, we are pleased to announce the most remarkable achievement in electronic watch technology to-date.

By combining the quartz-accuracy precision of the LCD watch with miniaturized alarm technology, we proudly introduce the first **CONTINUOUS DISPLAY ALARM WATCH**. A watch that may not be available from other sources for years can now be yours at a price hundreds of dollars less than you would imagine.

And now consider the incredible convenience of a portable alarm clock handsomely adorning your wrist at all times !!!

- Never again missing an appointment because you lost track of time.
- Never again missing a plane or a train because you didn't realize how late it had become.
- Never again forgetting to make that all-important phone call.
- Never having to worry about forgetting to take important medication on time.
- Never worrying about waking up from that catnap, or at a hotel if your wake-up call isn't on time.
- Always being aware of when you should be coming or going or doing all that your hectic schedule demands — without devoting your valuable time to trying to remember it all.

7:55AM

SET TO RING
AT 7:55 A.M.

THE ALARM

The MICRO-ALARM has a 24 hour Alarm System, allowing you to set your watch to signal at any minute of the day or night (1,440 settings per day are possible). Once set, you need not be concerned about your next appointment or train, plane or phone call. The MICRO-ALARM will remember for you and remind you when you need to be reminded.

SNOOZE/REMIND CONTROL

For your convenience the MICRO-ALARM will give one short beep prior to its full alarm cycle, allowing you to turn it off without disturbing others. If not deactivated after the first short beep, the alarm will then beep for 15 continuous seconds. Push the deactivate button twice and the alarm is off. However, should you want a further reminder, then push the deactivate button only once and the alarm will go through its cycle again in exactly 5 minutes, allowing you to continue your current activity whether it be a snooze or phone call without fear of forgetting your next commitment.

12:34 AND 56
SECONDS

12:34₅₆

6-DIGIT LCD DISPLAY

The MICRO-ALARM has a 6-digit readout showing hours, minutes and seconds at a glance. Since the readout is by Liquid Crystal Display (LCD) and not by Light Emitting Diode (LED), no button has to be pushed; the time is continuously displayed! A built in night-light functions at the push of a button for reading in darkness.

AUGUST 15th
FRIDAY

8:15 FR

CALENDAR DISPLAY

Just one push of the control button converts the display into a 3-function calendar; displaying the month, date of the month, and day of the week. The remarkable memory built into the module knows each month and the number of days in that month and resets automatically on the first day of the new month.

QUARTZ ACCURACY

The MICRO-ALARM is extraordinarily accurate. Its module is manufactured by Hughes Aircraft Company, one of the world's foremost manufacturers of micro-electronics, and is guaranteed accurate to within 3 minutes a year (averaging less than 15 seconds per month). You can depend on the accuracy year after year. There are no moving parts, so there is nothing to wear out or even require servicing. The result of this accuracy is that you can set your watch to the second.

THINK ABOUT IT!

Even if you have no consistent need for a watch with a built-in electronic alarm, the MICRO-ALARM is a valuable investment for its watch features alone:

1. It is the most up-to-date fully-functioning electronic watch available today.
2. It is accurate to +/- 15 seconds per month, and never has to be wound — put it on, and the time and date are correct even if it has been in a drawer for a month!
3. Its elegant styling will compliment any attire — and elicit compliments from your associates and friends.
4. At this price you can not find a better buy.
5. One day you will have a critical need to be reminded of a vital appointment — and then, having used the alarm function once, you will never again return to any other reminder system.
6. Why buy an ordinary watch when you can own a MICRO-ALARM?

ELEGANT MESH BRACELET

Each MICRO-ALARM comes with a 1 year limited warranty. You may order in your choice of gold-tone or silvertone case. Each for only \$69.95 plus \$1.99 for shipping and handling. Each MICRO-ALARM comes with a matching, elegant, thin mesh bracelet, more handsome and much more practical than those "pull over-snap" type bracelets. This band adjusts comfortably and easily, eliminating cumbersome link adjustments.

15 DAY TRIAL

Wear the MICRO-ALARM for 15 days to assure yourself that this is no ordinary watch. If at the end of that time you are dissatisfied for any reason you may return it for a prompt refund, no questions asked.

To order by credit card please phone our 24-hour toll-free number:

800-325-6400 ask for Oper. 36

In Missouri: 800-342-6600 ask for Operator 36

or mail the attached coupon with your payment and the MICRO-ALARM will be on its way to you.

Allow 3-4 Weeks For Delivery

Winthrop-Rogers Ltd. V5411

Box A69, 1135 Greenridge Rd., Buffalo Grove, IL 60090

Please send MICRO-ALARMS @ \$69.95 each plus \$1.99 for shipping and handling.

 Silvertone MICRO-ALARM

 Goldtone MICRO-ALARM

If I am not completely satisfied I may return it for a full refund. Total amount enclosed \$, check or money order. (Illinois residents please add 5% sales tax.) No C.O.D.s please.

Charge: ☐ Amer. Exp. ☐ Bank Amer./Visa ☐ Master Charge MCBK#

Card # Exp.

Signature

Name

Address Apt.

City State Zip

To expediate shipping by UPS, please provide street address rather than P.O. Box number.



New Products

Additional information on new products covered in this section is available from the manufacturers. Either circle the item's code number on the Reader Service Card inside the back cover or write to the manufacturer at the address given.

J.I.L. CB/AM-FM STEREO/CASSETTE UNIT

J.I.L.'s Model 615CB CB/car stereo/cassette unit features a 40-channel CB transceiver, an AM stereo FM receiver, and stereo cassette player in a single in-dash package. An easy-to-use control microphone puts all the CB functions at hand: thumbwheel channel selector, PTT control, r-f gain, LED channel readout. Complementing the controls on the mike are front-panel controls for CB/Radio-Tape mode selector, variable squelch, RX and TX indicator lights, and a stand-by con-



trol. The latter monitors CB while listening to cassettes or radio. Whenever a message comes through on a selected CB channel the circuit interprets the program then returns to it automatically at the end of the CB transmission. The cassette section includes controls for fast forward/eject and tape play indicator. The audio section delivers 5 W/ch rms power output at a frequency range of 50-10,000 Hz. \$369.95.

CIRCLE NO. 88 ON FREE INFORMATION CARD

ASTATIC POWER MICROPHONE

The Astatic Corporation has announced the introduction of its Model 1104C preamplified base-station communication microphone. Available in five colors, the new microphone features base-mounted slide controls for adjusting the gain of the amplifier for the proper modulation level and tone quality for individual voices. An adjustable master gain control is provided for preventing overmodulation and distortion. The mike is powered by a 9-volt battery and has a six-conductor coiled cord that can be wired for virtually any type of switching system in a transceiver. \$83.00.

CIRCLE NO. 91 ON FREE INFORMATION CARD

MICRO-ACOUSTICS PHONO CARTRIDGE

The new Model 530-mp is the top-of-the-line phono cartridge offered by Micro-Acoustics Corp. Each cartridge is supplied with an individual frequency curve. Rated frequency



response is 5 to 20,000 Hz $\pm 1\frac{1}{2}$ dB. Tracking force range is 0.7 to 1.4 grams, and cartridge weight is 4 grams. Claimed channel separation is 30 dB at 1000 Hz, 15 dB at 10,000 Hz. Output voltage is 3.5 mV each channel at 5 cm/s peak recorded velocity. Load requirements and cable capacitance are specified at 10,000 to 100,000 ohms and 100 to 1500 pF, respectively. Each stylus is light-beam oriented under a microscope. \$200.

CIRCLE NO. 92 ON FREE INFORMATION CARD

SBE MOBILE CB TRANSCEIVER

SBE's new Tahoe 40-channel AM CB transceiver measures only 7.25"D \times 4.5"W \times 1.4"H (18.4 \times 11.4 \times 3.6 cm) so that it can be installed in locations where space is at a premium, such as in a minicompact or sports car. The transceiver includes all the standard features and controls available with large rigs, including a large LED channel display. Included in the front panel are volume and squelch controls, channel selector, a PA switch, and a red transmit (TX) indicator that lights up when the transmitter is keyed. The transceiver includes PLL frequency synthesis and a double-conversion receiver circuit that employs a tiny four-pole bandpass filter.

CIRCLE NO. 93 ON FREE INFORMATION CARD

SANSUI STEREO FM RECEIVER

Sansui's Model G-3000 AM/stereo FM receiver has a rated power output of 26 watts per channel minimum rms with both channels driven into 8 ohms from 20 to 20,000 Hz, with a THD of 0.15%. The power amplifier features a differential input, Class A driver, and push-pull OCL output stages. Overall frequency response is said to be 10 to 50,000 Hz, ± 1 , -2 dB. The tuner section includes a PLL differential demodulator, quadrature detector, and a low-pass filter to suppress the



ultrasonic carrier. Harmonic distortion is rated a 0.18% monaural, 0.25% stereo. The phono preamp uses low-noise pnp Darlingtons transistors. Other features include microphone mixing with level control, signal strength and zero-center tuning meters, AM beat filter, loudness switch, tape monitor, FM muting, headphone jack, and a speaker selector switch. Measures 17 1/16" W \times 13 15/16" D \times 6 1/16" H (43.3 \times 35.4 \times 15.4 cm). \$280.

CIRCLE NO. 94 ON FREE INFORMATION CARD

HICKOK DUAL-TRACE 15-MHZ SCOPE

Hickok's Model 517 is a dual-trace, triggered-sweep oscilloscope with 15 MHz response to within 3 dB and claimed fool-proof triggering to 27 MHz (30 MHz typical). Vertical sensitivity varies from 10 mV/cm to 50 V/cm in 12 calibrated steps, and is continuously variable (uncalibrated) from 5 mV/cm to 50 mV/cm. Risetime is said to be 24 ns, and overshoot 3% or less. Input impedance is 1 megohm shunted by 30 pF. Operating modes are channel A only, B only, A and B chopped, A and B alternate, A + B (single trace algebraic sum), and B - A (single trace algebraic difference). The Model 517's time base has sweep rates of 0.5 μ s/cm to 0.2 s/cm in 18 calibrated steps. A X5 expander is switch selectable. Among the Model 517's features are internal, line, external, auto, slope, and TV sync triggering, TV sync separators, TTL-compatible Z axis (intensity) modulation, an 8- \times 10-cm display, and a regulated power supply. Includes two probes (10:1/direct and 10:1) and vectorscope overlay. Measures 17 1/2" D \times 14-5/8" W \times 7" H (44.5 \times 37.2 \times 17.8 cm) and weighs 13.5 lb (6.1 kg). \$695.

CIRCLE NO. 95 ON FREE INFORMATION CARD

PIONEER PROGRAM SOURCE SELECTOR

The Model U-24 program source selector from Pioneer adds to the number of inputs



and outputs usually available in conventional preamplifiers and integrated amplifiers. It makes available two AUX inputs; three phono inputs; four tape input/output jacks; tape-to-tape dubbing facilities; and three power amplifier outputs. All functions are pushbutton selectable. The switching circuits of the Model U-24 are positioned near the rear panel, adjacent to the actual input/output terminal board, to reduce the use of shielded cable and cut down on high-frequency losses due to stray capacitance.

CIRCLE NO. 96 ON FREE INFORMATION CARD

VISONIK SPEAKER SYSTEM

The Sub-1 subwoofer from Visonik of America, Inc., is designed to match the company's David 502 speaker system. The Sub-1 fea-

Let Walter H. Buchsbaum, one of the nation's leading electronics experts, show you

how 4 easy-to-use troubleshooting techniques can solve 99% of your electronic problems in record time!

Act now. Save \$10.97. Publisher's price: \$12.95.

Yours for just \$1.98.

Don't spend one minute more than is necessary on any troubleshooting job!

It's not a question of being lazy. It's just a matter of knowing a *sure and quick* way to find the defect. And that's the way you're going to know.

Walter H. Buchsbaum, one of the most respected authorities in electronics, has been collecting surefire troubleshooting methods for many years. From experts. In all areas of electronics. Now he's put the best of them, along with his own proven techniques, into **TESTED ELECTRONICS TROUBLESHOOTING METHODS**.

This book is presently selling for \$12.95. But, now you can have it for just \$1.98. YOU SAVE \$10.97!

It's our way of introducing you to the *Electronics Book Service*, the no-risk book club which is currently keeping over 50,000 technicians, troubleshooters and hobbyists informed of the best, more useful new books in the field of electronics.

TESTED ELECTRONICS TROUBLESHOOTING METHODS is typical of the selections we offer members. It gives you solid, expert help on all kinds of troubleshooting problems. It shows you how to *save time—money—and work*.

This is why we have chosen it to introduce you to the *Electronics Book Service*. Join now, as a trial member, and you'll receive your copy of **TESTED ELECTRONICS TROUBLESHOOTING METHODS**—for just \$1.98! This is your *only* financial commitment of membership. For the *Electronics Book Service* is a risk-free book club: As a member, you buy only what you want, when you want, and always at a substantial discount!

When you receive your copy of **TESTED ELECTRONICS TROUBLESHOOTING METHODS**, you'll learn an easy method that reduces the bulk of electronic repair to the simple application of 4 basic troubleshooting techniques. *Four minimum-time, maximum-efficiency procedures that will solve 99% of your electronic repair problems. And with record ease, speed and accuracy.*

- THE SYMPTOM-FUNCTION TECHNIQUE will quickly isolate the defect to a particular part of the equipment. Once you isolate the trouble spot. . .
- THE SIGNAL-TRACING TECHNIQUE will help you find the stage—amplifier—logic gate—or whatever the cause of the trouble.
- THE VOLTAGE-RESISTANCE TECHNIQUE will precisely pinpoint for you the defective component.
- THE VOLTAGE-SUBSTITUTION TECHNIQUE will verify the trouble and, in some types of equipment, find the solution from among the remaining possibilities.

These 4 basic techniques form the foundation for *all* successful troubleshooting. You can use them singly or in combination. They work like magic for all the top-level electronics experts. *And they'll work for you!*

And these 4 techniques aren't the only surefire troubleshooting techniques you'll find in **TESTED ELECTRONICS TROUBLESHOOTING METHODS**. Buchsbaum bring you a *whole* battery of time-saving, work-saving methods

—methods which the nation's most successful electronics experts are using.

For bonuses, Buchsbaum gives you additional guidelines for getting the most out of your equipment. You'll see how to test and calibrate all standard meters. Even how to get the most for your money when you select test equipment.

What's more, you'll discover methods for finding and solving intermittent defects—which are usually hard to find. And for dealing with interference defects—which are often mistaken for component failure.

TESTED ELECTRONICS TROUBLESHOOTING METHODS contains over 100 illustrations that simplify these methods and formulas the experts use. You'll have the circuit and block diagrams—tables—charts—schematics—and checklists that make Buchsbaum's troubleshooting techniques easy to apply.

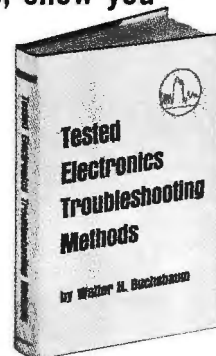
With this battery of simplified troubleshooting techniques, you'll be able to handle all kinds of electronic repair work *quickly—easily—economically*. And without wasting time—doing unnecessary extra work—or going through endless trial-and-error. For these reasons, **TESTED ELECTRONICS TROUBLESHOOTING METHODS** is a perfect introduction to the . . . **ELECTRONICS BOOK SERVICE**.

The *Electronics Book Service* does a job which you don't have time to do for yourself. We carefully screen the hundreds of books on the subject, select those which are the most useful or which bring you the latest information on technical innovations and improvements of prime importance.

Your membership is an ideal way to keep in touch with the onrushing advances in electronics and its applications—to keep on top of a rapidly changing technology.

As a member, you can build a professional library of superb quality and permanent value—one which will meet your every interest and requirement, always available for you to consult for expert help in any need. And you can acquire this library as quickly or as slowly as you choose.

Remember, the *Electronics Book Service* has *no minimum purchase requirements* as do many book clubs. Once you've paid \$1.98 for **TESTED ELECTRONICS TROUBLESHOOTING METHODS**, you don't need to purchase any further selections!



Why delay? Mail the coupon below to get your copy of this \$12.95 handbook for only \$1.98—and to receive all the benefits of membership in the *Electronics Book Service* on a risk-free trial basis. Fill out and mail your coupon right away.

Here is the practical and efficient way in which the Electronics Book Service operates.

1. When you enroll as a member, you receive—for only \$1.98 (plus postage and handling, with tax where applicable)—your copy of **TESTED ELECTRONICS TROUBLESHOOTING METHODS**. This is the *only* obligation you are committed to make.
2. You are under *no* obligation to accept any minimum number of selections within any time limit. *You can take as many or as few as you wish*. And, you may resign at any time with no obligation once you have paid for your copy of **TESTED ELECTRONICS TROUBLESHOOTING METHODS**.
3. On selections you do accept, your membership entitles you to a discount from the publisher's list price. This discount is available to members only and provides you with substantial savings.
4. Every four weeks we'll send you a free bulletin describing the current selection. If you want the selection, no action is required; it will be shipped to you automatically. If you don't want it, just return the card enclosed with the bulletin.
5. You have at least 10 days to decide whether you want the selection or not. Return the card so we receive it no later than the date specified. If you don't have 10 days to answer and receive an unwanted selection, return it at *our* expense.
6. Each bulletin also describes a number of alternate or additional selections, also available to you at the special discount price for members.

— FILL OUT AND MAIL THIS COUPON TODAY. —

ELECTRONICS BOOK SERVICE

Dept. 6651-P1(5), P.O. Box 42
West Nyack, N.Y. 10994

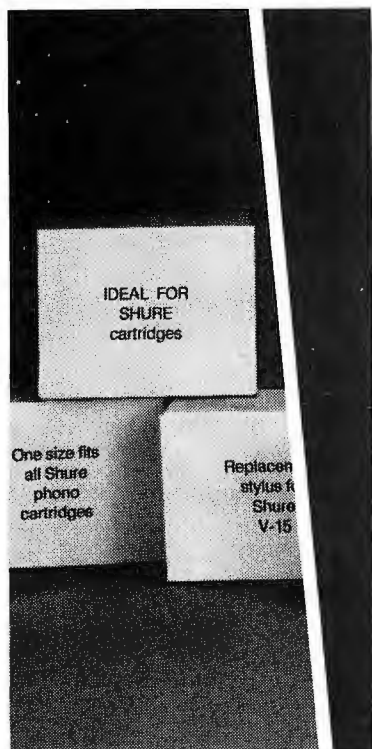
Please enroll me in Electronics Book Service on a risk-free trial basis. I am to receive announcements free of charge, and will be entitled to full privileges as a member—without obligation to buy any specific number of club selections. As my first selection under this trial membership, send me **TESTED ELECTRONICS TROUBLESHOOTING METHODS** for only \$1.98 (plus postage and handling, with tax where applicable).

Name

Address

City State Zip

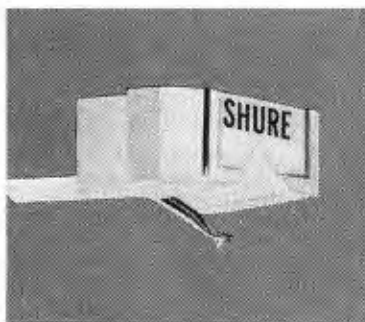
Offer limited to new members (U.S. and Canada) only.



Needle in the hi-fi haystack

Even we were astounded at how difficult it is to find an adequate other-brand replacement stylus for a Shure cartridge. We recently purchased 241 random styli that were not manufactured by Shure, but were being sold as replacements for our cartridges. Only ONE of these 241 styli could pass the same basic production line performance tests that ALL genuine Shure styli must pass. But don't simply accept what we say here. Send for the documented test results we've compiled for you in data booklet # AL548. Insist on a genuine Shure stylus so that your cartridge will retain its original performance capability—and at the same time protect your records.

Shure Brothers Inc.
222 Hartrey Ave., Evanston, IL 60204
In Canada: A.C. Simmonds & Sons Limited



Manufacturers of high fidelity components, microphones, sound systems and related circuitry.
CIRCLE NO. 55 ON FREE INFORMATION CARD



tures a 12" (30-cm) woofer and matrix crossover. The D-502, an improved version of the David 50, is said to have an improved woofer and crossover network. A LED in the D-502 flickers when the tweeter reaches its power-handling limit to warn the user of an overdrive condition. The Sub-1/D-502 combination is rated to handle up to 200 watts/channel, while minimum driving power is specified to be 40 watts/channel. Frequency response of the system is rated at ± 2 dB from 28 to 20,000 Hz. Crossover is nominally at 160 Hz. The Sub-1 is available in a walnut wood cabinet with dark brown grille (\$450) or dark gray cabinet with handles, black foam grille, and bright metal surround (\$500). The D-502 and Sub-1 are available separately.

CIRCLE NO. 97 ON FREE INFORMATION CARD

HAMMOND AUDIO EQUIPMENT RACK

The Audio-File equipment rack from Hammond Industries, Inc. is designed to house



stereo equipment in a rack that takes up 22" \times 19" (55.9 \times 48.3 cm) of floor space and stands 48" (121.9 cm) high. The brushed aluminum mainframe is accented with black Plexiglass side panels. The Audio-File is available in kit form for \$350. It is also available in a Decor Matching Kit of aluminum-only design for about \$210, which gives the buyer the opportunity of selecting panels and shelves to color match existing decor. Address: Hammond Industries Inc., 155 Michael Dr., Syosset, NY 11791

CIRCLE NO. 98 ON FREE INFORMATION CARD

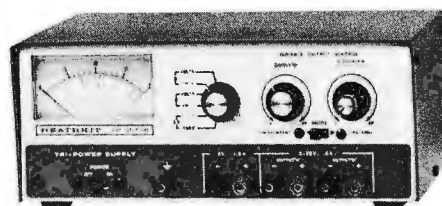
SENCORE CB SCOPE CONVERTER

Sencore's Model CB44 27-MHz CB scope frequency converter allows the display of CB modulation envelopes on any oscilloscope having a 1-MHz vertical bandwidth. In operation, the CB44's input cable is attached to the transceiver's antenna output jack and the scope probe is attached to universal output loops on the converter's enclosure. Power for the converter circuitry is taken from the incoming CB signal. An internal dummy load dissipates the transceiver's r-f output. A 1.2-V p-p max. output at the transmitted frequency is also provided for use with frequency counters. The CB-44 can be used on any of the 40 CB channels. \$75.

CIRCLE NO. 99 ON FREE INFORMATION CARD

HEATH TRI-OUTPUT POWER SUPPLY

The Heath Company's new Model IP-2718 experimenter's power supply kit has three



floating outputs that can be interconnected as the user desires. A fixed 5-volt output at 1.5 A dc and two variable 0-to-20-volt outputs at 0.5 A dc each are available at front-panel binding posts. The two variable outputs can be tracked to "follow" each other at any specified voltage difference. All outputs are short-circuit protected with current limiting. They can be operated independently, in series, or in parallel. A switchable front-panel meter monitors output voltages and currents. The supply is also available factory assembled, Model SP-2718. Prices are \$80 (IP-2718) and \$140 (SP-2718).

CIRCLE NO. 90 ON FREE INFORMATION CARD

AUDIO-TECHNICA TONEARM LIFT

The Model AT6005 pneumatic tonearm lift from Audio-Technica is designed to add a built-in cueing feature to turntables not so equipped. The arm operates by air pressure



rather than fluid to eliminate leakage and pressure changes that often occur as a result of changes in temperature. The lift mechanism is said to be easily mounted on most turntable bases and raises the tonearm 9/64" (3.6 mm). For flexible mounting, the lift comes with a 20" (50.8-cm) rubber tube that permits placing the lift actuator on any turntable base location. \$30.

CIRCLE NO. 100 ON FREE INFORMATION CARD

THE FEEL OF MUSIC

The Realistic[®] Mach One isn't just for your ears!

Multicell midrange horn

Provides a true spatial image. Smooth 800-8000 Hz response for a "live" presence.

Heavy-duty tweeter horn

Delivers crisp and clean highs from 8000 to 25,000 Hz.

Treble, midrange L-pads

Calibrated controls for precise adjustment of response to suit room acoustics.

Oiled walnut veneer

We make speaker positioning easy by including a cabinet with the look and feel of fine furniture — so the Mach One looks great anywhere!



Removable grille

The sturdy grille frame snaps on and off for easy access to the response controls.



Massive 15" woofer

The acoustic suspension, large-excursion cone has an effective radiating area of over 100 square inches—the equivalent of a huge air-pump — for bass you can feel all the way down to 20 Hz. The four-layer voice coil is wound on a brass form for heavy power handling capacity—over 100 watts peak program material.

A great loudspeaker doesn't just please your ears. It reproduces deep bass with a power and punch your entire body feels . . . it recreates the live ambience so accurately that when you close your eyes, you're "on location" in that auditorium, concert hall or night spot . . . and it delivers top performance with both moderate and high-powered amplifiers. If you think we're talking about a \$400 speaker, you haven't experienced the Mach One. For under \$200 each*, you get incredible "live theatre" sound from a name you can depend on: Realistic. Backed by 56 years in audio design, manufacture, sales and service. So bring in your favorite record for a Mach One audition, and discover the feel of music.

*Retail price may vary at individual stores and dealers.

SOLD ONLY WHERE YOU SEE THIS SIGN:

Radio Shack[®]

A TANDY COMPANY • FORT WORTH, TEXAS 76102
OVER 6000 LOCATIONS IN NINE COUNTRIES



FREE! New '78 Catalog

Come in for your copy and see what's *really* new in electronics. 164 pages, 100 in full color. 2000 exclusive items.

HOBBYISTS! ENGINEERS! TECHNICIANS! STUDENTS!

Write and run machine language programs at home, display video graphics on your TV set and design microprocessor circuits — the very first night — even if you've never used a computer before!

SPECIFICATIONS

ELF II features an RCA COSMAC COS/MOS 8-bit microprocessor addressable to 64k bytes with DMA, interrupt, 16 registers, ALU, 256 byte RAM, full hex keyboard, two digit hex output display, 5 slot plug-in expansion bus, stable crystal clock for timing purposes and a double-sided plated-through PCB board plus RCA 1861 video IC to display any segment of memory on a video monitor or TV screen.

USE ELF II FOR...

GAMES

Play interactive keyboard games, games with analog inputs, games utilizing your TV set for a video display!

GRAPHICS

Create pictures, designs, alpha-numerics and fabulous animated effects on your TV screen for hour after hour of family fun!

CIRCUIT DESIGN

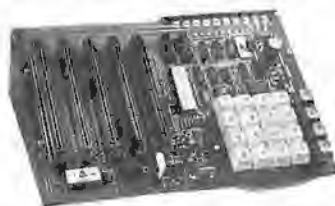
Design circuits using a microprocessor. Use ELF II as a counter, alarm system, lock, controller, thermostat, timer, telephone dialer, etc. The possibilities are infinite!

Coming Soon!

Exclusive Netronics Plug-In Program Debugger and monitor allows visual display of any program on a clock pulse by clock pulse basis to help you learn programming fast! • 4k memory • Cassette I/O • D to A, A to D • Controller plug-ins.

RCA COSMAC microprocessor/mini-

computer



A THOUGHTFUL GIFT FOR ANYONE WHO MUST STAY UP TO DATE IN COMPUTERS AND ELECTRONICS!

ELF II \$99⁹⁵

SEND TODAY

NETRONICS R&D LTD., Dept. PE11

333 Litchfield Road, New Milford, CT 06776 Phone (203) 354-9375

Yes! I want to run programs at home and have enclosed:

☐ \$99.95 plus \$3 p&h for RCA COSMAC ELF II kit. Featured in POPULAR ELECTRONICS.

Includes all components plus everything you need to write and run machine language programs plus the new Pixie chip that lets you display video graphics on your TV screen. Designed to give engineers practice in computer programming and microprocessor circuit design, ELF II is also perfect for college and college-bound students (who must understand computers for any engineering, scientific or business career). Easy instructions get you started right away, even if you've never used a computer before!

As your need for computing power grows, five card expansion bus (less connectors) allows memory expansion, program debugger/monitor, cassette I/O, A to D and D to A converters, PROM, ASCII keyboard inputs,

controllers, etc. (soon to be available as kits). Manual includes instructions for assembly, testing, programming, video graphics and games plus how you can get ELF II User's Club bulletins. Kit can be assembled in a single evening and you'll still have time to run programs, including games, video graphics, controllers, etc., before going to bed! ☐ \$4.95 for 1.5 amp 6.3 VAC power supply, required for ELF II kit. ☐ \$5.00 for RCA 1802 User's Manual.

☐ I want mine wired and tested with the power transformer and RCA 1802 User's Manual for \$149.95 plus \$3 p&h. Conn. res. add sales tax.

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

☐ Send info on other kits!

Dealer Inquiries Invited

CIRCLE NO. 38 ON FREE INFORMATION CARD



New Literature

ALLISON SPEAKER CATALOG

Allison Acoustics' new catalog describes its line of loudspeaker systems. An introductory section explains the operating principle of Allison's convex-diaphragm, mid-range and tweeter drivers and how its room-matched speaker systems generate flat power output. Comprehensive mechanical, electrical and performance specifications for each model are included. Address: Allison Acoustics, Inc., 7 Tech Circle, Natick, MA 01760.

UL SAFETY REQUIREMENT SPECS

"How to Specify Products That Meet UL Safety Requirements" is a new brochure from Underwriters Laboratories, Inc. Written in a question and answer format, the guide provides information on the specification of products, materials and systems that meet UL requirements. Address: Underwriters Laboratories, Inc., Public Information Office, 207 E. Ohio St., Chicago, IL 60611.

CITIZENS BAND BOOKLET

"The ABC's of CB" by Sparkomatic discusses the components of a CB system and what to check before buying them; FCC rules and regulations; and the advantages of owning a CB radio. A glossary of code terms and a list of sample "handles" are also included. Price, 50 cents. Address: Sparkomatic Corp., Milford, PA 18337.

ALEXANDER BATTERY CATALOG

An 8-page catalog from Alexander Manufacturing describes its line of batteries for communications and portable video equipment. Nickel-cadmium and alkaline-mercury batteries are listed, including a line of replacement batteries for ENG video tape recorders and cameras. Comprehensive electrical specifications are provided. A section describing the company's automatic battery chargers is also included. Address: Alexander Manufacturing Co., Box 1645, Mason City, IA 50401.

CONSUMER GUIDE TO METRICS

The Commerce Department's National Bureau of Standards has revised and updated its guidebook "What About Metric?" The new edition includes changes that resulted from the passage of the Metric Conversion Act of 1975, and explains how the metric system will be used on a daily basis with common measures and weights problems. Price, 35 cents. Address: Consumer Information Center, Pueblo, CO 81009.

POPULAR ELECTRONICS

FREE

McIntosh CATALOG and FM DIRECTORY

Get all the newest and latest information on the new McIntosh Solid State equipment in the McIntosh catalog. In addition you will receive an FM station directory that covers all of North America.



MX 113

FM/AM STEREO - AM TUNER AND PREAMPLIFIER

SEND TODAY!

McIntosh Laboratory, Inc.
East Side Station P.O. Box 96
Binghamton, N.Y. 13904
Dept. PE

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

If you are in a hurry for your catalog please send the coupon to McIntosh.

For non rush service send the Reader Service Card to the magazine.

CIRCLE NO. 36 ON FREE INFORMATION CARD

MAGAZINES AT DISCOUNT!

You SAVE up to 50%

Here's your chance for a real bargain bonanza on your favorite magazines. You may select as many as five of these titles at the special introductory rates shown below—up to 50% off! To order, indicate the magazines you want by inserting their code numbers in the boxes on the attached order card. Or write to: MAGAZINES AT DISCOUNT, A Division of Ziff-Davis Publishing Co., P.O. Box 2703, Boulder, Colorado 80322.

CODE NOS.

- (02) **CAR & DRIVER** You pay only \$4.99
Reg. Rate: 12 Issues for \$9.98
- (70) **CAR CLASSICS** You pay only \$8.98
Newsstand Rate: 6 Issues for \$15.00
- (03) **CYCLE** You pay only \$4.99
Reg. Rate: 12 Issues for \$9.98
- (04) **FLYING** You pay only \$9.97
Reg. Rate: 12 Issues for \$14.00
- (71) **FOUR WHEELER** You pay only \$5.49
Reg. Rate: 12 Issues for \$9.50
- (28) **MECHANICS ILLUSTRATED** You pay only \$5.96
Reg. Rate: 18 Issues for \$9.97
- (06) **POPULAR ELECTRONICS** You pay only \$6.99
Reg. Rate: 12 Issues for \$12.00
- (07) **POPULAR PHOTOGRAPHY** You pay only \$4.99
Reg. Rate: 12 Issues for \$9.98
- (35) **POPULAR SCIENCE** You pay only \$5.97
Reg. Rate: 18 Issues for \$11.91
- (08) **PSYCHOLOGY TODAY** You pay only \$6.97
Reg. Rate: 12 Issues for \$12.00
- (58) **ROLLING STONE** You pay only \$9.00
Reg. Rate: 26 Issues for \$18.00
- (09) **SKIING** You pay only \$4.99
Reg. Rate: 7 Issues for \$7.98
- (38) **SPORTS ILLUSTRATED** You pay only \$9.97 (Reg. Rate)
Newsstand Rate: 26 Issues for \$11.91
- (11) **STEREO REVIEW** You pay only \$3.99
Reg. Rate: 12 Issues for \$7.98
- (40) **TIME** You pay only \$12.50
Newsstand Rate: 25 Issues for \$25.00
- (41) **TV GUIDE** You pay only \$8.35
Lowest Available Sub. Rate for 32 Issues
- (90) **TV GUIDE** You pay only \$13.56
Lowest Available Sub. Rate for 52 Issues





Stereo Scene

By Ralph Hodges

NEW TESTS FOR LOUDSPEAKERS

THE MORE I think about it, the more convinced I become that your typical little neighborhood hi-fi test lab is nowhere without—at the very least—a spectrum analyzer. A colleague dropped in the other day with his Hewlett-Packard 3580A, in order to examine a lacquer disc he had just had mastered at a downtown studio. The ease with which he rocketed through a series of tests that would have taken me endless time and interconnecting cables (only to find out, much later, that what I had measured was the hum from some faulty ground) was most depressing.

With practice my friend has become a fair hand with his instrument, so that he was halfway finished with his work before I had abandoned my search for an unused ac wall outlet (not realizing that the H-P has a self-contained battery pack). So now, contemplating my only recently acquired and quite conventional THD and IM analyzers, I know how a modern commando might feel when he must face the world armed only with a stone axe. Furthermore, things have gotten to the point where some people feel that even a spectrum analyzer is primitive equipment. "Your basic spectrum analyzer is okay, to be sure, but it doesn't begin to achieve its full usefulness until interfaced with your basic laboratory computer." And etcetera.

The Well-Tested Speaker. What the new shape of test instrumentation will mean to the development and evaluation of loudspeakers is as yet a little hard to say. Several speaker manufacturers and even a few speaker reviewers have embraced the new technology for its awesome power, particularly in studies relating to loudspeaker performance in the time domain. Here, there appears to be much remaining to be accomplished. To date their work has generally shown that, yes, in the objective sense, the typical loudspeaker's performance is every bit as bad as we all suspected. Thus, we have been left to puzzle out why devices that measure so bad can

manage to sound so good to our ears.

On the other hand, the new measurement techniques have permitted some appreciable (objective) improvements in these areas of speaker performance, and the products embodying them have been marching into the marketplace in steadily increasing numbers. So far, most reviewers have found that the best of these is every bit as good as the best speaker systems designed without benefit of the new techniques. However, they have not as yet had any universally persuasive or consistent reason to declare them any better.

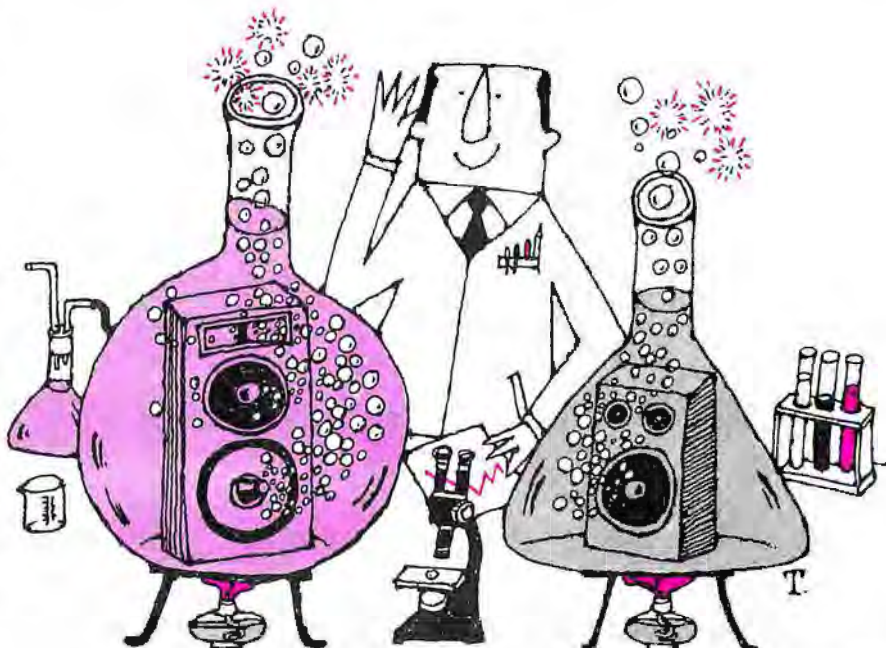
For example, in recent years holography has provided a whole new way of studying the behavior of loudspeaker diaphragms. And, sure enough, coherent-light photographs have shown time and again that speaker cones move as ideally rigid pistons a lot less of the time than we would like. In particular, photographs of tweeter domes have revealed that as frequency increases, there is often a tendency for the central region of the dome to physically decouple from the periphery near the voice coil. In effect, under high accelerations the center

of the dome tries to stand still, turning the diaphragm into a ring radiator instead of an integral piston. Since a ring radiator of this type has undesirable dispersion characteristics, it has been suggested that a cone tweeter with a small-diameter voice coil is likely to exhibit better dispersion at very high frequencies than a dome. However, the plausibility of this case notwithstanding, you'll notice that the popularity of the dome device has not perceptibly declined with speaker designers. For many applications it apparently remains the best *compromise* between power-handling ability and acceptable dispersion, and the sophistication with which its misbehavior can be measured has not yet changed the situation very much.

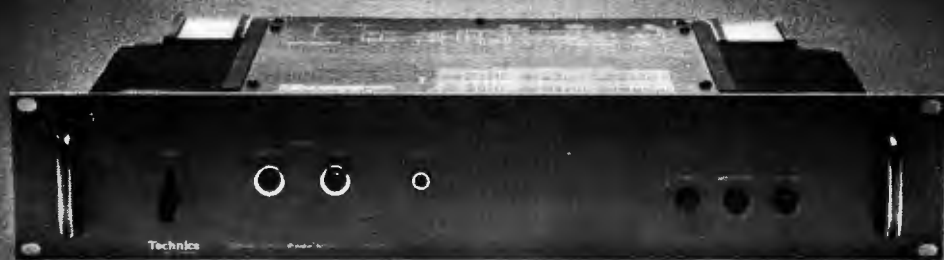
Isolating Meaningful Distortion.

Elsewhere, the new techniques and instrumentation show signs of leading to immediate and meaningful progress. In the August 1977 *Stereo Review*, Peter Fryer of Rank Hi Fi in England describes investigations into several postulated loudspeaker faults (Doppler distortion, for example) that no one has yet really succeeded in pinning down. These were all phenomena that are difficult to measure, and hence their effects on the music-listening experience have not been characterized or quantified. Instead of trying to measure them as they exist in available products, Fryer artificially generated these distortions through various means and injected them (in known amounts) into speakers he had reason to believe were acceptably free of them to begin with.

When Fryer was finished, the "mys-



There are few DC amplifiers in the world
with THD as low as 0.02%.
But there's only one priced under \$400.



Introducing the Technics SE-9060 stereo/mono DC amplifier. Its concept is simple: amplification with inaudible distortion.

How Technics achieved this elusive goal is not quite so simple. Like the difference our newly developed dual FETs make in the current mirror-load differential amplifier. They enable the SE-9060 to achieve the DC stability necessary for the highest gain in the crucial first stage.

Another difference is the constant current load and current feedback used in the voltage amplifier to reduce distortion to a minimum. A minimum so low it is barely detectable with the most advanced measuring equipment.

But inaudible distortion was not the engineers' only goal. That's why Technics SE-9060 is a DC amplifier. Each amp section and the NFB loop is direct coupled without the use of any capacitors. So the SE-9060 not only has inaudible distortion, it also

boasts flat frequency response from DC to 100 kHz with almost nonexistent phase shift.

In addition to all the improvements in the amplifier stages, Technics also eliminated all signs of transient distortion with completely independent power supplies for each channel.

Compare specifications and prices. And you'll realize there's no comparison for the SE-9060.

POWER OUTPUT: 70 watts per channel (stereo), 180 watts (mono) min. RMS into 8 ohms from 20 Hz to 20 kHz with no more than 0.02% THD. INTERMODULATION DISTORTION (60 Hz: 7 kHz, 4: 1): 0.02%. FREQUENCY RESPONSE: DC-100 kHz, ± 0 dB, -1 dB. POWER BANDWIDTH: 5 Hz-50 kHz, -3 dB. S/N: 120 dB (IHF A). RESIDUAL HUM & NOISE: 100 μ V. INPUT SENSITIVITY & IMPEDANCE: 1 V/ 47k Ω . SUGGESTED RETAIL PRICE: \$399.95*

Technics SE-9060. A rare combination of audio technology. A new standard of audio excellence.

*Technics recommended price, but actual retail price will be set by dealers.

Technics Professional Series
by Panasonic

tery distortion" that stood out as being most irritating to listeners, even in relatively small amounts, was a rather prevalent distortion that he calls "delayed resonance." Delayed resonance is simply whatever "sound" of a resonance persists after the input signal to the loudspeaker has ceased. *Because* it persists, it is presumably less subject to psychoacoustic masking than a distortion that cuts off with the input. Fryer reports he confidently expected the sharp, "high-Q" type of resonance to be the most objectionable to listeners. It wasn't. It seems such resonances involve so narrow a band of frequencies that most program material sets them off relatively rarely. Nor were broadband low-Q resonances a problem; they tended to be heard as equalization errors, and could be equalized out effectively. No, it was the intermediate conditions that raised the most objection—something that would not have been obvious without these investigations.

Measuring Delayed Resonances.

From the evidence of Fryer's work, it appears that something quite definite is now known about a rather elusive loudspeaker fault. Where can we go with this knowledge? Very shortly, if not immedi-

ately, we can go into newly instrumented laboratories well equipped to examine complicated acoustic phenomena on a real-time basis. The sort of work done by JVC in computer-derived acoustic-wave-form representations (as reported in this column last year) has been continuing rapidly. And it happens that Fryer's work largely coincided with the development at Acoustic Research of a computer system that draws frequency-response plots of a loudspeaker's output at time intervals as closely spaced as fifty millionths of a second (as shown in the diagrams). AR refers to this process as the "fingerprinting" of a speaker system, and the result as a transient decay plot. It begins with the speaker's stimulation by an impulse—a "gunshot" type of input, well-defined in duration and involving all audio frequencies. The test microphone's pickup then undergoes spectrum analysis which goes to a computer to evolve the frequency-response plots shown, advancing along a time axis that extends into the paper and begins at the top of the diagrams.

Part A of the figure shows the poorer loudspeaker, and the response irregularities are precisely those delayed resonances studied by Fryer. Note that they occupy small-to-medium band-

widths, tending to confirm Fryer's view that moderate-Q resonances are the worst degraders of audio quality.

Interestingly, the AR computer will provide these graphical data in three dimensions (using the overlaid red and green lines once employed by 3-D comic books), so that a sort of landscaped profile of response plots receding into the page can be viewed. Our editorial budget does not provide for this kind of printing (or for the red- and green-lensed goggles that would have to be bound into the magazine in order for you to see it properly), so you'll have to take my word for it.

Doppler Distortion Revisited. After all these years there seems still to be no agreement about Doppler distortion. Can it be heard? If so, under what circumstances? And is it likely to be troublesome with real program material played on real audio systems? While Fryer's investigations were busy disproving the importance of Doppler distortion as an audio "problem," other voices were raised to indict it once again.

Doppler distortion is a frequency modulation of a high frequency or frequencies by a low frequency, taking place

CAN YOU OUTSMART OUR COMPUTER?

Don't be too sure. The computer built into Parker Brothers' new game Code Name: Sector™ is capable of making thousands of calculations per second. It's as powerful as early computers that filled entire rooms and sold for millions of dollars. And, while it gives you clues to track down and sink a hidden electronic submarine, it also helps the sub escape and counter-attack. That's the catch that makes every game a real challenge. Whether you're playing alone or against others, your toughest opponent is the computer. Code Name: Sector™, the new electronic board game from Parker Brothers. It's a game with a mind of its own.



©1977 Parker Brothers Division of General Mills Fun Group Inc., Salem, Mass. 01970.



CIRCLE NO. 44 ON FREE INFORMATION CARD

Introducing the Technics ST-9030 tuner. Purists would feel better if it cost over \$1,000.



To some, tuners that offer 0.08% THD, 50 dB stereo separation, a capture ratio of 0.8 dB and waveform fidelity should demand a price tag of over \$1,000. But with the ST-9030 this performance can be yours for under \$400*.

That's quite a feat for a tuner. But then the ST-9030 is quite a tuner. It has two completely independent IF circuits: A narrow band, for ultra-sharp selectivity. And a wide band, for ultra-high separation and ultra-low distortion. It even selects the right band, depending on reception conditions, automatically.

Both bands give you the same extended flat frequency response. Because, unlike conventional tuners, the ST-9030 utilizes an electronic pilot cancel circuit that cuts the pilot signal, without cutting any of the high end. It's ingenious. And a Technics innovation.

The Technics ST-9030 has one of the quietest, most sensitive front ends of any tuner. With an advanced linear frequency 8-ganged tuning capacitor and 3 double-tuned circuits, plus dual gate MOS

FETs in the 2-stage RF amplifier and balanced mixer circuit. What's more, there's a servo tuning circuit that locks into the tuned frequency, regardless of minor fluctuations. The result: Negligible drift distortion and maximum stereo separation.

Technics ST-9030. Compare specifications. Compare prices. And you'll realize there's really no comparison.

THD (stereo): Wide—0.08% (1kHz). Narrow—0.3% (1kHz). S/N: 80 dB. FREQUENCY RESPONSE: 20Hz—18 kHz +0.1, —0.5 dB. SELECTIVITY: Wide—25 dB. Narrow—90 dB. CAPTURE RATIO: Wide—0.8 dB. Narrow—2.0 dB. IF, IMAGE and SPURIOUS RESPONSE REJECTIONS (98 mHz): 135 dB. AM SUPPRESSION (wide): 58 dB. STEREO SEPARATION (1 kHz): Wide—50 dB. Narrow—40 dB. CARRIER LEAK: Variable —65 dB (19 kHz). Fixed —70 dB (19 kHz, 38 kHz). SUGGESTED RETAIL PRICE: \$399.95*

Technics ST-9030. A rare combination of audio technology. A new standard of audio excellence.

*Technics recommended price, but actual retail price will be set by dealers.

Technics Professional Series
by Panasonic

CIRCLE NO. 59 ON FREE INFORMATION CARD

ISO TIP

cordless
soldering
iron for
heavy-use
applications.

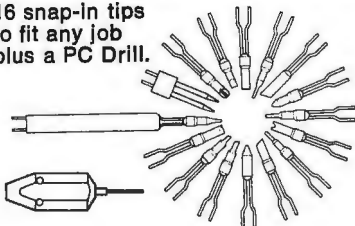


Complete
recharge in an
hour;

partial recharge
for use in a
few minutes.

Up to 125 electronic joints or more
per charge. Low voltage, battery
powered, ground free isolated tip
design. Ask your electronics dealer.

16 snap-in tips
to fit any job
plus a PC Drill.



WAHL CLIPPER CORPORATION
Originators of Practical Cordless Soldering
Sterling, Illinois 61081 • (815) 625-6525
"Manufacturing Excellence Since 1919"
CIRCLE NO. 62 ON FREE INFORMATION CARD

Try this exciting new hobby!

Build
your own electronic concert
organ. It's easy. No technical
knowledge required. Just
follow the clearly pictured
instructions of the famous
Wersi do-it-yourself system.
Choose from seven different
models. Send \$2.00
(refundable) with coupon for
colorful 104 page catalog.

WERSI



Wersi Electronics, Inc.
Dept. 42, Box 5318
1720 Hempstead Road
Lancaster, PA 17601

Enclosed is \$2.00 for my copy of your 104 page catalog.

Name _____
Address _____
City _____ State _____ Zip _____

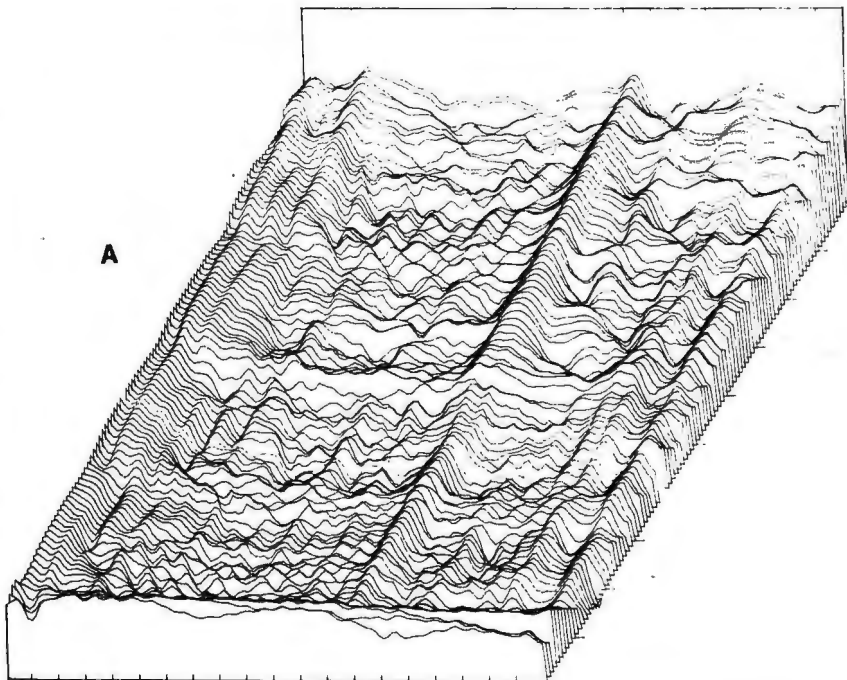
when a single loudspeaker diaphragm is called upon to reproduce both. Woofers are usually the accused agents when Doppler distortion is cited, because theirs are the only diaphragms making large enough in-and-out excursions to make the effect possible at all.

Fryer used frequencies within the audio range in experiments that seemed to prove that Doppler effects virtually never achieve sufficient magnitude to be audible with typical hi-fi speakers. Now, Tomlinson Holman of Apt Corporation reports that it is precisely those frequencies *outside* the audio range that are going to cause the trouble: specifically, frequencies from record warps and deformations, which peak in energy around 4 to 6 Hz on many record players (as a re-

sult of arm-cartridge resonance). It happens that the ear's sensitivity to flutter also peaks at about 4 Hz. Moreover, it is certain that the woofer of an air-suspension or ported speaker system will be undergoing very large excursions if it is being stimulated by any significant amount of 4-Hz energy.

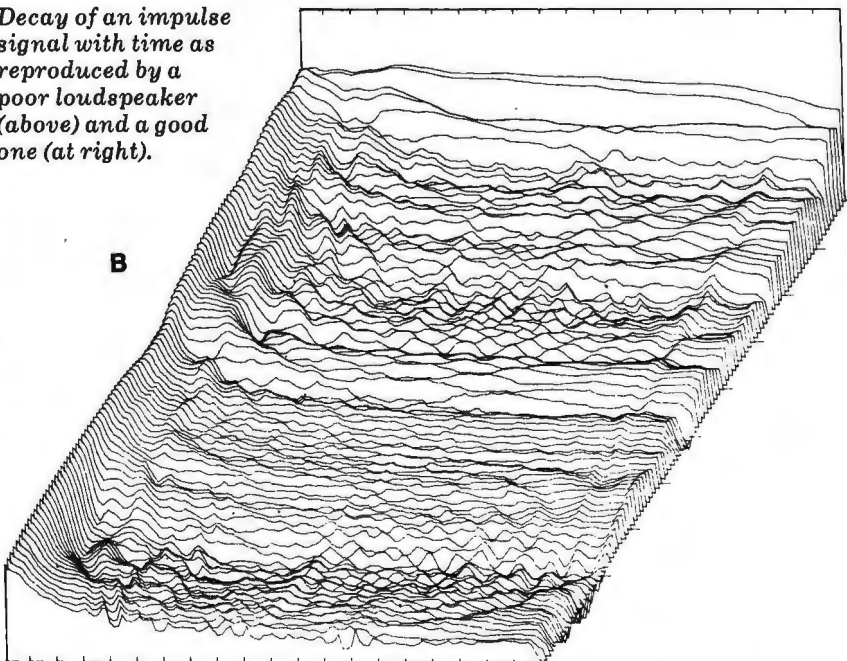
Holman confidently claims that he has heard and demonstrated Doppler effects produced by infrasonic signals any number of times, and that this is the primary reason for the steep low-cut filter he builds into his phono preamplifiers. I cannot yet report on this matter from first-hand experience, but I can at least pass along the information for the benefit of those readers who would like to look into it themselves. ◇

A



*Decay of an impulse
signal with time as
reproduced by a
poor loudspeaker
(above) and a good
one (at right).*

B



WHAT THE EXPERTS CALLED THE BEST LAST YEAR WASN'T GOOD ENOUGH FOR US.

"IT CANNOT BE FAULTED."
SA 9500-STEREO REVIEW
"AS NEAR TO PERFECT AS WE'VE
ENCOUNTERED." TX 9500-POPULAR
ELECTRONICS
"CERTAINLY ONE OF THE BEST ... AT ANY
PRICE." TX 9500-MODERN HI FI



SA 9500II

Last year, the experts paid Pioneer's integrated amps and tuners some of the highest compliments ever.

But rather than sitting back and resting on our laurels, we set out to build even better amps and tuners. Amps and tuners that would not only surpass anything we'd ever built before, but anything anyone ever built before.

Our new TX 9500II tuner is a perfect example.

Its front end features three newly developed field effect transistors that work to let you pull in beautiful FM reception no matter how far you live from the transmitter.

It has separate bandwidths for weak and strong stations. Which means you can filter all the noise out of weak stations without worrying about overfiltering strong ones.

And where most tuners have multiplex circuits that accidentally cut out some of the frequencies that add depth and presence to the music, the multiplex circuit in the TX 9500II preserves them. So the music begins to sound as

if it's coming live from your living room, instead of from some radio station miles away.

Naturally, after developing a tuner this advanced, we had no choice but to create an amplifier that could match it.

That amplifier is our new SA 9500II. A fully



TX 9500II

integrated amplifier that's capable of producing a continuous power output of 80 watts per channel RMS into eight ohms, from 20 to 20,000 hertz, with no more than 0.1% total harmonic distortion.

In other words, an amp that cannot only reproduce the entire audible frequency range of every conceivable instrument, but an amp that can reproduce *all* music with a total harmonic distortion level well under what the human ear can hear.

Obviously, both the SA 9500II and the TX 9500II are very sophisticated pieces of equipment. But all of the engineering skill that went into making them has gone into every tuner and amplifier in our new series II. No matter what the price, no matter what the specifications.

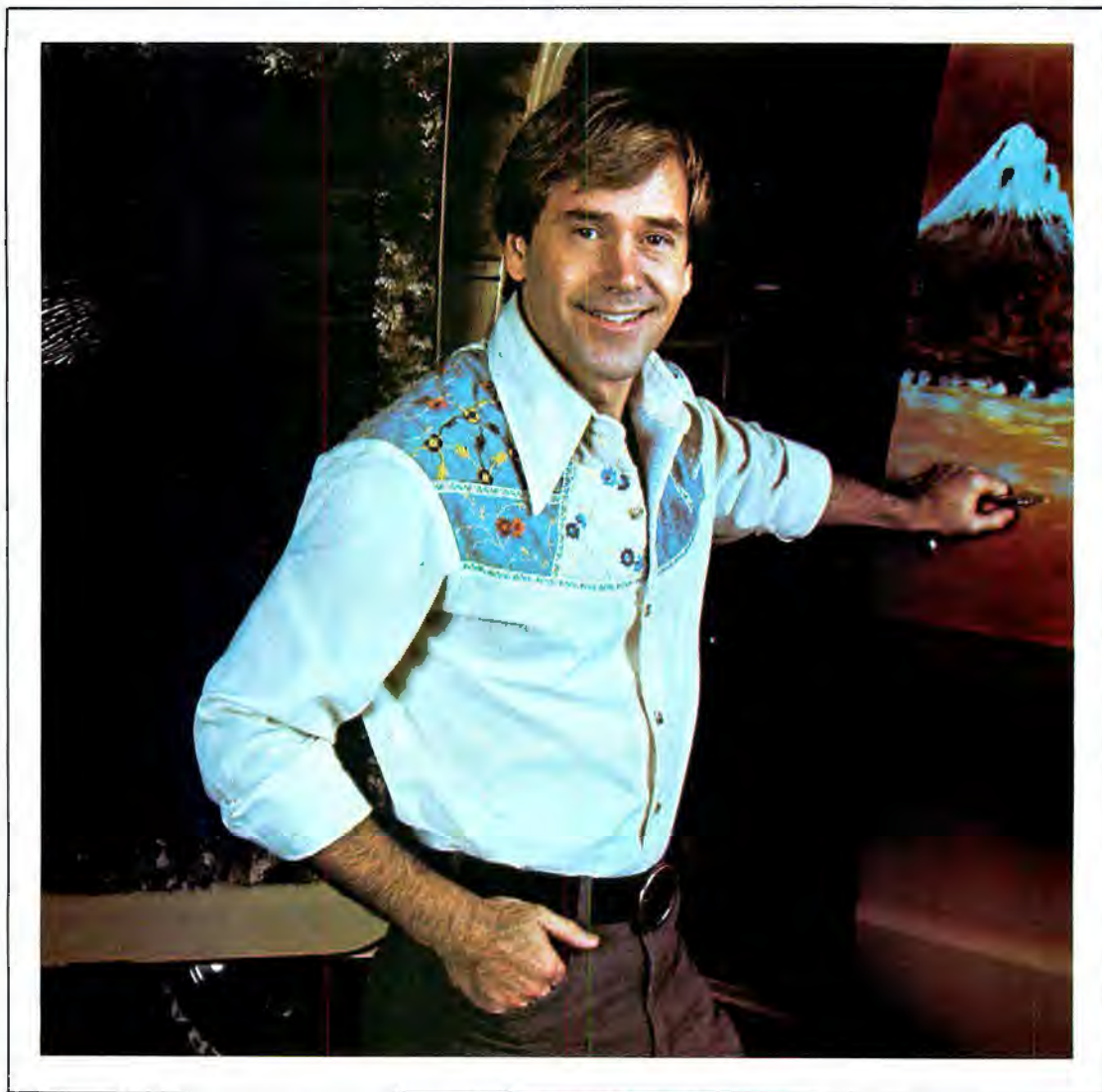
And that's something you don't have to be an expert to appreciate.

High Fidelity Components

PIONEER®
WE BRING IT BACK ALIVE.

© 1977 U.S. Pioneer Electronics, 85 Oxford Drive, Moonachie, New Jersey 07074.

You gotta shop around.



**When you do, you'll probably pick CIE.
You can't afford to settle for
less when it comes to something like
electronics training that could
affect your whole life.**

When you shop around for tires, you look for a bargain. After all, if it's the same brand, better price—why not save money?

Education's different. There's no such thing as "same brand." No two schools are alike. And, once you've made your choice, the training you get stays with you for the rest of your life.

So, shop around for your training. Not for the bargain. For the best. Thorough, professional training to help give you pride and confidence.

* * *

If you talked to some of our graduates, chances are you'd find a lot of them shopped around for their training. They pretty much knew what was available. And they picked CIE as number one.

Why you should shop around yourself.

We hope you'll shop around. Because, frankly, CIE isn't for everyone.

There are other options for the hobbyist. If you're the ambitious type—with serious career goals in electronics—take a close look at what we've planned for you at CIE.

What you should look for first.

Part of what makes electronics so interesting is it's based on scientific discoveries—on ideas! So the first thing to look for is a program that starts with ideas and builds on them!

That's what happens with CIE's Auto-Programmed® Lessons. Each lesson takes one or two principles and helps you master them—before you start using them!

How practical is the training?

This is the next big important question. After all, your career will be built on what you can do—and on how well you do it.

Here are ways some of CIE's troubleshooting programs help you get your "hands-on" training...

With CIE's Experimental Electronics Laboratory...



you learn and review the basics—perform dozens of experiments. Plus, you use a 3-in-1 precision Multimeter to learn testing, checking, analyzing!



When you build your own 5 MHz Triggered-Sweep, Solid-State Oscilloscope you take your first real professional step. You use it as a doctor uses an X-ray machine—to "read" waveform patterns... lock them in... study, understand and interpret them!

When you get your Zenith 19-inch Diagonal Solid-State Color TV you



Pattern simulated.

apply your new skills to some real on-the-job-type troubleshooting! You learn to trace signal flow... locate malfunctions... restore perfect operating standards—just as with any sophisticated electronics equipment!



When you work with a completely Solid-State Color Bar Generator—actually a TV signal transmitter—you study up to ten different patterns on your TV screen... explore digital logic circuits... observe the action of a crystal-controlled oscillator!

Of course, CIE offers a more advanced training program, too. But the main point is

simply this:

All this training takes effort. But you'll enjoy it. And it's a real plus for a troubleshooting career!

Do you prepare for your FCC License?

Avoid regrets later. Check this out before you enroll in any program.

For some troubleshooting jobs, you must have your FCC License. For others, employers often consider it a mark in your favor. Either way, it's government-certified proof of specific knowledge and skills!

More than half of CIE's courses prepare you for the government-administered FCC License exam. In continuing surveys, nearly 4 out of 5 CIE graduates who take the exam get their Licenses!

Shop around... but send for CIE's free school catalog first!

Mail the card. If it's gone, cut out and mail the coupon. If you prefer to write, mention the name and date of this magazine. We'll send you a copy of CIE's FREE school catalog—plus a complete package of independent home study information! For your convenience, we'll try to have a representative contact you to answer your questions. Mail the card or coupon—or write: CIE, 1776 East 17th St., Cleveland, OH 44114.

CIE Cleveland Institute of Electronics, Inc.

1776 East 17th Street, Cleveland, Ohio 44114
Accredited Member National Home Study Council

☐ **YES...** I'm shopping around for the **right** kind of career training in electronics troubleshooting—and CIE sounds well worth looking into. Please send me my FREE CIE school catalog—including details about troubleshooting courses—plus my FREE package of home study information!

PE-46

Print Name _____

Address _____ Apt. _____

City _____

State _____ Zip _____

Age _____ Phone _____
(area code)

Check box for G.I. Bill information:
☐ Veteran ☐ Active Duty

Mail today!



Audio Reports

DYNAMIC CROSSTALK

TO ANYONE who remembers when 1% distortion was considered to be "negligible," the refinement of modern amplifiers is nothing less than amazing. Conventional distortion measurements, either of harmonic or intermodulation components, can now be made only with the aid of the most sophisticated test instruments, and few people would seriously claim that a total harmonic distortion measurement of 0.002% implies a better sounding amplifier than one of 0.02%.

Nevertheless, amplifier designers continue to search for ways to improve the performance of their products. Admittedly, the audible benefits of most recent "improvements" are quite subtle, and in some cases debatable. Usually, the "improvement" is not measurable by established techniques, necessitating the creation of new measurement methods or instrumentation. A case in point is the so-called "dynamic crosstalk" effect, which has received attention from a number of amplifier manufacturers. This is a very-low-frequency phenomenon in which a powerful transient at a low audio or subaudible frequency is present in one stereo channel but influences the output of the other channel. It is the result of a common power supply impedance, where a large current drawn by one channel causes a temporary shift of the operating voltages in the other channel. In an extreme case, it is claimed, this can modulate the program in the second channel with the low-frequency transient in the first channel.

One might ask, how does this differ from ordinary intermodulation distortion? As I see it, it differs in two basic respects: First, the low- and high-frequency signals are not present in the same program channel, so that the intermodulation occurs only through interactions via the common power supply impedance. Second, the IM effect is not caused by a direct modulation of one waveform by another, but rather by the *envelope* of a low frequency transient affecting higher-frequency signals. This being so, no IM would be detectable in a conventional steady-state measurement, but only when a low-frequency transient occurs.

If this effect exists, the most logical way to eliminate it is by separating the power supplies for the two channels (assuming that the amplifier circuits have already been designed to minimize the effects of transient supply voltage changes). This can be done at

minimum expense by using separate rectifier and filter systems with a common power transformer. A more complete isolation results from using separate power transformers as well for the two channels.

This was the approach taken by the designers of the Mitsubishi Model DA-A15 amplifier reviewed here. Of course, this use of separate power supplies and transformers is not new. Harman-Kardon has employed separate power transformers for some years in its receivers and amplifiers and, more recently, this feature has been used in amplifiers from Kenwood, Pioneer, and other well-known manufacturers.

Two questions naturally come to mind. Can the effect of separate power supplies (or the lack thereof) be measured, and can it be heard? Dynamic crosstalk can be measured by applying a low-frequency transient signal (such as a pulse, square wave, or tone burst) to one channel and a high-frequency continuous signal, or no signal at all, to the other channel. The magnitude of low-frequency output in the second channel, compared to that in the first, is a measure of the crosstalk between channels, and the modulation imposed on the high-frequency signal, if any, is a measure of the probable effect of such crosstalk on program material.

In our laboratory tests, the crosstalk on amplifiers with dual power supplies has been too low to measure, and the tests were not applied to enough conventional amplifiers to provide a basis for comparison. Another test, potentially more sensitive, is to drive one channel with a low-level, high-frequency signal (we used 10,000 Hz at 0.1 watt) and the other channel with a 10-Hz square wave at full power, such as 100 watts. When the high-frequency signal is displayed on a spectrum analyzer, using a narrow, high resolution scan, it should be possible to see the sidebands resulting from even very low modulation percentages. (Our Hewlett-Packard Model 3580A analyzer can reveal such sidebands down to a -90-dB or lower level, corresponding to less than 0.003%). Even with this technique, no modulation effects have been visible on dual power supply amplifiers.

Much more pertinent is the second question, however. If it cannot be heard on conventional amplifiers, "dynamic crosstalk" can hardly be considered a serious problem in sound reproduction, and its elimination, however praiseworthy, is of secondary impor-

tance. I have never heard anything that could be identified as "dynamic crosstalk." To me, amplifiers lacking such crosstalk sound exactly like others that presumably are not immune to the effect.

This is not to say that dynamic crosstalk does not exist. Under laboratory measurement conditions, with the appropriate test signals, it certainly does (or can) exist. However, a little thought will reveal why it is not, and cannot be, a significant effect from the listener's viewpoint. Stereo channel separation at very low frequencies is drastically degraded compared to the midfrequency separation in stereo discs (and sometimes in FM tuners). This is of little importance, since real music has little or no separation (directionality) at very low frequencies. Thus, a low fre-

quency transient, should it exist, will be present in both playback channels at the same time, at nearly the same level. Any direct crosstalk will be masked by the high-level signal already present in the other channel, and intermodulation of higher frequencies will be masked by the high level of those signals. It is difficult to imagine any "real world" condition, as opposed to contrived laboratory conditions, in which dynamic crosstalk might be heard (unless it were of extraordinary amplitude).

As things stand, I must conclude that "dynamic crosstalk" is one of the lesser aberrations with which we have to cope in sound reproduction and is hardly worth the effort and expense lavished by some manufacturers on its elimination.

MITSUBISHI MODEL DA-P10 PREAMPLIFIER AND MODEL DA-A15 BASIC POWER AMPLIFIER

Preamp and power amplifier can be combined for 150 watts/channel integrated amplifier.



Mitsubishi, a major manufacturer in Japan, has entered the U.S. market with a line

of unusual deluxe high-fidelity components. Two of these, tested here, are the Model DA-P10 preamplifier and Model DA-A15 basic power amplifier. They are sold as separate components but are physically and electrically designed so that they can be joined to form a single integrated amplifier. The power amplifier is rated to deliver 150 watts/channel into 8 ohms at 20 to 20,000 Hz with less than 0.1% harmonic and IM distortion when driven by a 1-volt input. The preamplifier has a nominal 1-volt output but can actually deliver up to 9 volts output to drive any amplifier on the market.

The handles supplied with the amplifier can be installed at the user's option. When in place, they permit the preamplifier to bolt into place to form a single

rigid and heavy unit. Another option, not tested here, is a peak-indicating power meter in place of the preamplifier. In this case the latter must be used as a separate component.

The Model DA-P10 preamplifier measures 16 $\frac{3}{4}$ "W \times 8"D \times 6 $\frac{3}{4}$ "H (42.5 \times 20.4 \times 17 cm) and weighs 13 lb (5.8 kg). The Model DA-A15 power amplifier has the same width and height dimensions and is 11 $\frac{3}{4}$ " (28.5 cm) deep and weighs 40 lb (18 kg). The nationally advertised value of the preamplifier is \$290; the power amplifier is \$590.

General Description. The most interesting feature of the two units is their complete separation of the two signal channels. Mitsubishi calls this design approach "Dual Monaural" construction. The Model DA-P10 is literally two independent monaural preamplifiers that share only a common transformer (separate regulated power supplies are used

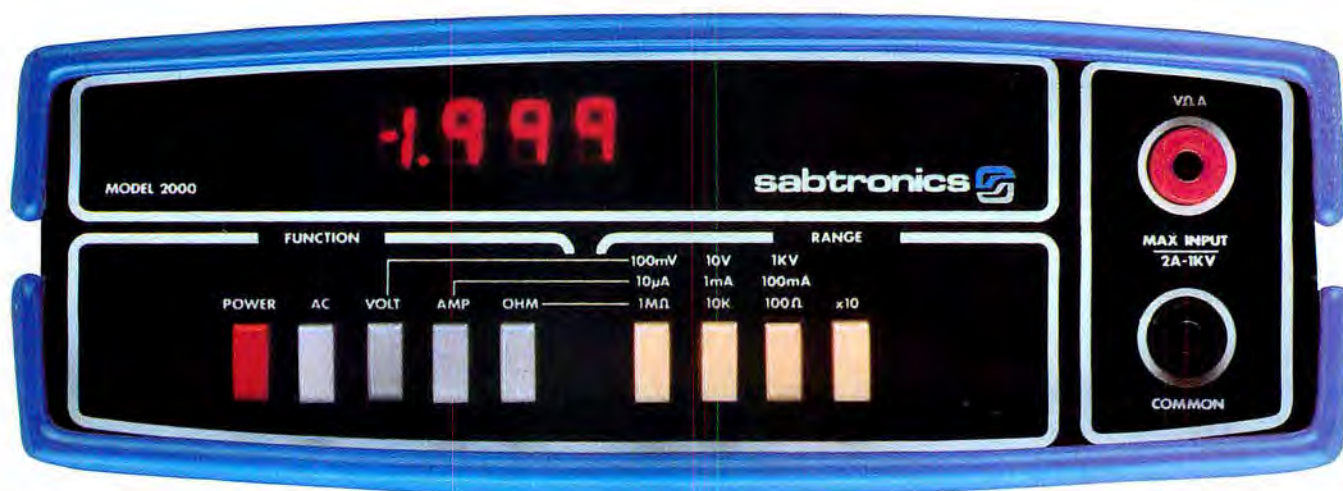
for the two channels), function selector, volume control, and chassis. In the power amplifier, the separation is even more complete, since each channel has its own power transformer as well.

The controls for each of the preamplifier's channels are arranged in a horizontal row. They include a switch for a subsonic filter with a 12-dB/octave rate below 18 Hz, 11-position BASS and TREBLE tone controls (with center DEFEAT settings), and a LEVEL control. The large ATTENUATOR knob, common to both channels, is lightly detented at 2-dB intervals over much of its range, with the steps increasing in magnitude as the control nears its -60-dB setting. In the final counterclockwise position, the ATTENUATOR control shuts off the signal entirely.

Lever switches along the bottom of the control panel permit selection of stereo or mono MODE, activating and deactivating the TAPE MONITOR function, and turning on and off the POWER. The input SELECTOR at the upper right of the panel has positions for two magnetic phono cartridges and two high-level sources (TUNER and AUX). There is a PHONES jack that is designed to drive low-impedance (8-ohm) phones from a separate amplifier stage within the preamplifier.

At the upper left of the panel is a SPEAKERS switch that can connect either of two pairs of speaker systems but not both to the power amplifier or silence all speakers for headphone listening. To accomplish this, the power amplifier's speaker outputs are not brought into the

Chances are, someone you know just bought a professional 3½ digit DMM kit for less than \$70.



Thousands of people have already bought the Sabtronics Model 2000 . . . for two main reasons. First, its incredible accuracy, range and professional features. And second, the incredibly low price of \$69.95.

People everywhere appreciate this bench/portable multi-meter. They depend on its basic DCV accuracy of 0.1% ± 1 digit, its readings to ± 1999 and its five functions giving 28 ranges, overload protection and 100% overrange.

The 2000 is automatically appealing to hobbyist and professional alike. With automatic overrange indication, automatic polarity, even automatic zeroing.

Best of all, it's easy to assemble. All the parts you'll need, including the high-impact case, come right along with the clear, step-by-step instructions.

The result is a professional quality 3½ digit DMM that you could have paid a lot more than \$69.95 for . . . possibly receiving a lot less. But this one's from Sabtronics, specialists in digital technology.

Maybe you should order yours before you turn the page.



Made in U.S.A.

sabtronics

INTERNATIONAL INC.

P.O. Box 64683 Dallas, Texas 75206 (214) 369-7310

GUARANTEE:

Our guarantee to you; examine the 2000 DMM kit for 10 days. If you're not satisfied, return it unassembled for a full refund of purchase price.

SPECIFICATIONS:

DC volts in 5 ranges: 100 μ V to 1000V
AC volts in 5 ranges: 100 μ V to 1000V
DC current in 6 ranges: 100nA to 2A
AC current in 6 ranges: 100nA to 2A
Resistance: 0.1 Ω to 20M Ω in 6 ranges
AC frequency response: 40Hz to 50KHz
9mm (.36") LED display
Input impedance: 10M Ω
Size: 8"W x 6.5"D x 3"H
(203W x 165D x 76H mm)

Power requirements: 4 "C" cells (not included)

To: Sabtronics International, Inc.
P.O. Box 64683, Dallas, TX 75206

EH78

Please send me _____ Sabtronics Model 2000 DMM kit(s) at \$69.95 each. _____ subtotal

Shipping and handling, \$5.00 per unit* _____ subtotal
Texas Residents Add Sales Tax _____

TOTAL enclosed _____

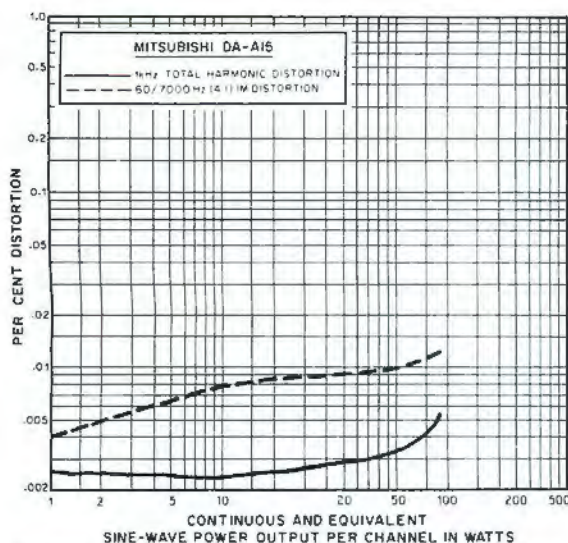
Name _____

Street Address _____

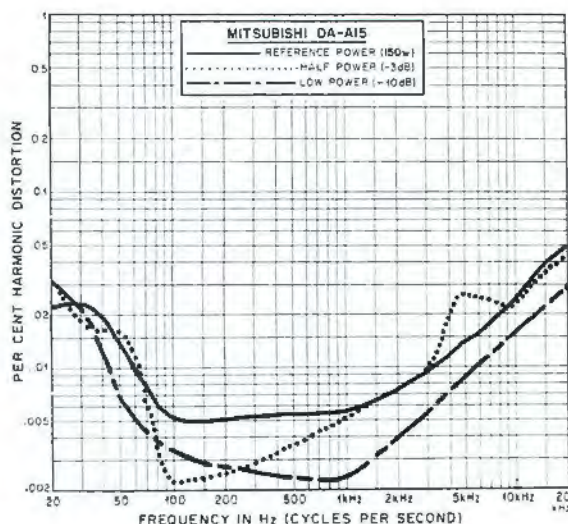
City _____

State _____ Zip _____

*USA only. Canada \$6.50. All other countries, \$10.00 (surface mail)



Total harmonic distortion and 60/7000-Hz distortion



Harmonic distortion at three power levels

preamplifier as is sometimes done. Instead, the switch controls relays within the power amplifier. The relays then control speaker switching and are part of the amplifier's protective system that disconnects the outputs in the event of a malfunction and provides a few seconds of delay when power is initially applied.

The signal connectors are recessed into the right side of the preamplifier.

The power amplifier has no operating

controls other than a pair of screwdriver-adjustable input level controls near the input connectors and a speaker selector slide switch that is used when the amplifier is driven by preamplifiers other than the Model DA-P10. Two pairs of insulated screw-type speaker terminals are provided. The large heat sinks for the output transistors occupy the two sides of the chassis, while the two power transformers and power supply filter ca-

pacitors occupy the space between the heat sinks.

When the power amplifier and preamplifier are joined together, a remote-control cable links their speaker selector sockets and a short cable joins the preamplifier outputs to the power amplifier inputs. The power cord of the power amplifier plugs into one of the switched ac receptacles on the preamplifier. The various cables can be folded



NOT ALL THREE-HEAD CASSETTE DECKS ARE CREATED EQUAL.

Some manufacturers have designed their decks with separate erase, record and playback heads primarily for convenience. So you can tape monitor as you record.

But our new KX-1030 uses separate heads primarily for performance. Each designed with the optimum gap to record or play back sound more accurately.

As a result, the KX-1030 has a frequency response of 35-18,000 Hz (± 3 dB using CrO₂ tape).

And to let you take full advantage of the separate record and playback heads, the KX-1030 has a Double Dolby[®] system with separate circuits for the record amplifier and the playback preamplifier. That way, as you record with Dolby, you can also tape monitor with Dolby, so you hear the sound precisely as it's being recorded.

The KX-1030 also has a Variable Bias Adjustment

Control and a built-in oscillator, so you can adjust the exact bias for the type or brand of tape you use.

We also built in a number of other features like MIC/LINE mixing, memory rewind and a peak indicator.

But as good as all this sounds, wait until you hear the price. Because at \$375.00*, no other cassette deck can match the performance and features of our new KX-1030.

Of course, the only way you're really going to appreciate the KX-1030 is to visit your Kenwood dealer. Once you do, you'll be convinced: Performance, convenience, and value set the KX-1030 apart from all the rest.



*Dolby is the trademark of Dolby Laboratories, Inc.

**Nationally advertised value. Actual prices are established by Kenwood dealers.

KENWOOD

For the Kenwood Dealer nearest you, see your yellow pages, or write Kenwood, 15777 S. Broadway, Gardena, CA 90248

and concealed in special channels along the side of the power amplifier. The channels are styled to resemble the heat sink fins above them.

The electrical performance specifications of the amplifier and preamplifier are impressive. In addition to being rated to deliver 150 watts/channel at very low distortion, the amplifier's specified channel separation is 90 dB at 1000 Hz and 80 dB at 20,000 Hz, while the unweighted hum and noise in the output is rated at less than 0.3 mV with a shorted input. The preamplifier's specified 1-volt output is actually rated to deliver a maximum of 9 volts. Depending on the frequency and input source, its channel separation is rated at 80 to 100 dB, and its phono input overload level at 1000 Hz is specified as 270 mV.

Laboratory Measurements. We laboratory tested the power amplifier and preamplifier separately, but for listening tests, we joined the two and used them as an integrated amplifier. The tone controls of the preamplifier had a variable bass turnover frequency. The bass boost or cut began at frequencies from 100 to 400 Hz, depending on how far the control was moved from its center position. The treble response curves were hinged at about 2000 Hz. The maximum range of the tone controls was about ± 12 dB, which is more than sufficient for their purpose but not so great as to invite the possibility of misuse. At their DEFEAT settings, the tone controls produced a completely flat response, within ± 0.5 dB from 20 to 20,000 Hz.

The RIAA equalization was equally accurate, well within the normal limits of measurement error. It measured within ± 0.5 dB from 20 to 20,000 Hz, including the effect of the response of the basic amplifier with tone controls defeated. It did not change detectably when measured through the inductance of typical phono cartridges. The subsonic filter dropped the output by 2.3 dB at 20 Hz and 14 dB at 5 Hz.

The rated 1-volt output of the preamplifier was developed with a high-level input of 145 mV or a phono input of 1.95 mV. The phono overload point was an excellent 310 mV. The unweighted noise output of the preamplifier was below our measurement capability of 100 μ V (80 dB below 1 volt) through the high-level inputs and measured -79.2 dB through the phono inputs. This is the lowest phono preamplifier noise level we have yet measured.

The outputs of the preamplifier clipped at 10.3 volts. At the rated 1-volt

level, the THD was 0.0025% at 1000 Hz (approximately the instrument residual distortion level), 0.0056% at 15,000 Hz, and 0.047% at 20 Hz. At 3 volts output, which is more than sufficient to drive any power amplifier to its full output, the distortion at these three frequencies was 0.0063%, 0.01%, and 0.05%. The IM distortion rose from 0.012% at 1 volt to 0.03% at 3 volts output.

The power amplifier passed the one-hour preconditioning period at one-third rated power without difficulty. A novel feature is the use of temperature sensors on the amplifier's heat sinks that change color from red to black at 140° F (60° C). This alerts the user to the fact that the heat sinks should not be touched with the bare hand. This is all academic because at no time during our tests did the sensors change color.

The outputs clipped at 178 watts/channel into 8-ohm loads at 1000 Hz. The 4- and 16-ohm outputs measured 267 and 112 watts, respectively. The distortion of this amplifier was among the lowest we have yet measured and, under most conditions, it was apparently less than the residual of our test instruments, which is approximately 0.002%. At 1000 Hz, the measured THD was 0.0022% to 0.0027% from 0.1 watt to 10 watts output. It rose to 0.0036% at 100 watts and to 0.0056% at 180 watts, just at the clipping point. The IM distortion was 0.004% to 0.008% up to 10 watts and 0.013% at 180 watts. Unlike almost every other amplifier we have tested, the distortion of this amplifier did not rise at very low power levels. Although the IM measurements indicated an apparent rise from 0.004% in the vicinity of 1 watt to 0.032% at a few milliwatts, this proved to be the random noise within the intermodulation analyzer.

At the rated 150-watt output, the THD was about 0.02% between 20 and 30 Hz and about 0.005% from 100 to 1000 Hz. It rose smoothly to 0.04% at 20,000 Hz. At lower-power outputs the shape of the distortion curve was similar, although the percentages were generally less. The amplifier was driven to a reference output of 10 watts by a 0.27-volt input, and the unweighted noise output was a very low -87 dB referred to 10 watts. The square-wave rise time of 0.7 μ s was exactly as rated, and the measured slew rate of 20 V/ μ s was slightly better than the rated 15 V/ μ s.

We also measured the interchannel crosstalk, since it is claimed to be a special quality of the amplifier. With the aid of our Hewlett-Packard Model 3580A spectrum analyzer, we were able to ver-

ify that the crosstalk was -120 dB at 20 Hz, -110 dB at 1000 Hz, and -80 dB at 20,000 Hz. These figures not only meet or surpass the manufacturer's claims, they are well-nigh unmeasurable without the use of sophisticated and expensive test equipment.

User Comment. Both the power amplifier and the preamplifier are handsomely finished in semigloss black, and the latter has a satin-finished aluminum front panel with matching metal knobs. The power amplifier's major components—power transformers, filter capacitors, and heat sinks—are exposed to view instead of being hidden by a dust cover or cabinet, resulting in a most attractive piece of equipment. When the two units are joined together, they form an integrated amplifier system of exceptional power and performance, with a combined depth of only 16 $\frac{3}{4}$ " (42.4 cm).

In its S/N, distortion, flatness of response, and interchannel isolation, the system is far above the norm. A few other amplifiers can match one or more of its individual characteristics, but none we have yet tested show the overall perfection of performance exhibited by this preamplifier/power amplifier system.

In the quest for certain levels of electrical performance, Mitsubishi engineers have chosen to eliminate some functions commonly found on lesser amplifiers. We concur with the omission of "loudness compensation," although the separate level controls on each preamplifier channel, in addition to their channel balance functions, would also have made it possible to add a well-designed loudness compensation system to its maximum effectiveness. Similarly, the absence of a high-cut filter is hardly a drawback, in view of the ineffectiveness of most such filters. On the other hand, we were surprised to see an amplifier of this quality and price with provision for only one tape recorder, since even medium-priced receivers often can control two tape decks, thus providing cross-dubbing capability.

No stereo program will have more than 30 dB or so of midrange isolation between channels (considerably less at the frequency extremes), which would make the 100-dB isolation of the Mitsubishi amplifier a case of "overkill." However, if normal crosstalk levels are a source of audible signal degradation, as it is sometimes claimed, the Mitsubishi amplifier certainly sets a standard for the industry. Interestingly, the channel isolation is so great here that it would be possible to use the DA-P10/DA-A15 com-

bination as two independent mono amplifiers with completely different programs and have no audible interaction or crosstalk between them.

We have said nothing about the sound of the Mitsubishi preamplifier/

amplifier for the simple reason that, like other fine amplifiers, it has no sound. The special appeal of this system lies in its superb construction, uncompromising quality standards, and general aura of elegance. For those who have no

need for the full power of the Model DA-A15, the company's Model DA-A10 is available at a lower price. Except for its 100 watt rating, it is identical to the Model DA-A15.

CIRCLE NO. 101 ON FREE INFORMATION CARD

DUAL MODEL 1245 AUTOMATIC TURNTABLE

Belt-driven automatic player provides extremely quiet operation.



The Dual Model 1245 is a two-speed, belt-driven automatic player. It boasts features

such as the improved tonearm used on the company's expensive Model CS721.

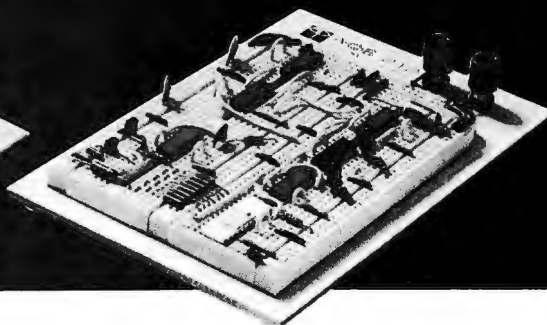
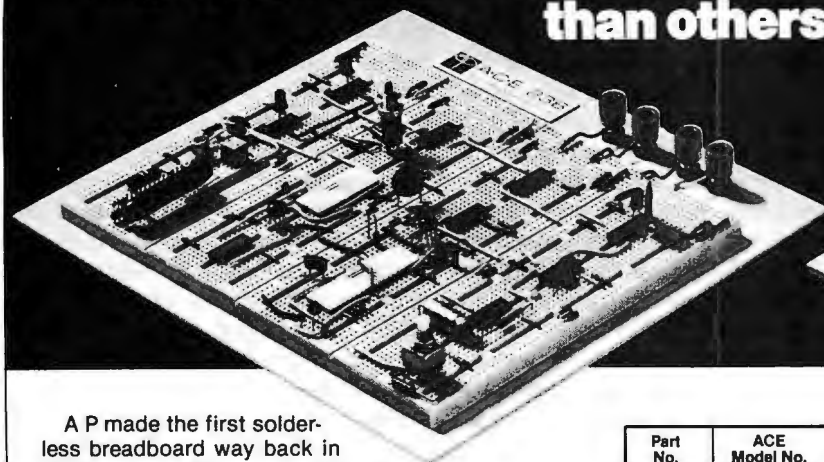
The tonearm is 8.7" (22.1 cm) from stylus to pivot and has a dual counterweight structure, with an inner mass suspended elastically from the outer shell. This reduces the effect of the bass resonance of the mass of the tonearm and cartridge compliance, lowering its

amplitude and distributing it over a wider frequency range.

The player is supplied installed on a wood-trimmed plastic base, with a hinged clear plastic cover that remains open at intermediate angles. Even the platter is mounted in place, leaving only the cartridge to be installed to make the player ready to be put into service. The record player in its base measures 14 $\frac{3}{4}$ "W x 14 $\frac{1}{2}$ "D x 5 $\frac{7}{8}$ "H (37.5 x 36.8 x 15 cm) and weighs 14 pounds (6.4 kg). Nationally advertised value is \$230.

General Description. The tracking force dial, located on the side of the tonearm's gimbal pivot structure, is calibrated from 0 to 3 grams at 0.1-gram intervals over the lower half of the range. On the motorboard, next to the base of

Why ACE solderless breadboards are more reliable than others.



A P made the first solderless breadboard way back in 1968, and we still make them best.

Because our experience taught us to avoid the pitfalls that can mean circuit errors. We do it by paying attention to details. Like using non-corrosive nickel-silver in our frankly superior terminals. And like using a vinyl-insulated back that prevents short circuiting. That's why you can count on the reliability of our solderless boards when you specify A P ACE All Circuit Evaluator Boards, Super Strips™, Terminal and Distribution Strips.

Order from your A P distributor today. For the name of the distributor nearest you call Toll-Free 800-321-9668.

Faster and easier is what we're all about.

Part No.	ACE Model No.	Tie Points	DIP Capacity	No. Buses.	No. Posts	Board Size (inches)	Price Each
923333	200-K (kit)	728	8 (16's)	2	2	4-9/16x5-9/16	\$18.95
923332	208 (assem.)	872	8 (16's)	8	2	4-9/16x5-9/16	28.95
923334	201-K (kit)	1032	12 (14's)	2	2	4-9/16x7	24.95
923331	212 (assem.)	1224	12 (14's)	8	2	4-9/16x7	34.95
923326	218 (assem.)	1760	18 (14's)	10	2	6-1/2x7-1/8	46.95
923325	227 (assem.)	2712	27 (14's)	28	4	8x9-1/4	59.95
923324	236 (assem.)	3648	36 (14's)	36	4	10-1/4x9-1/4	79.95

Send for our complete A P catalog, The Faster and Easier Book.

**A P PRODUCTS
INCORPORATED**

Box 110 • 72 Corwin Drive
Painesville, Ohio 44077
216/354-2101 TWX: 810-425-2250





TVT-6
Low cost
Direct Video
Display

only \$35

Don Lancaster's ingenious design provides software controllable options including:

- Scrolling • Full performance cursor
- Over 2K on-screen characters with only 3MHz bandwidth
- Variety of line/character formats including 16/32, 16/64
.....even 32/64
- User selectable line lengths

TELL ME MORE!

() Send instruction manual for the TVT-6 Kit with full operational details. \$1 enclosed.

Name: _____

Address: _____

City: _____ State: _____ Zip: _____

PAIA
ELECTRONICS, INC.

() SEND FREE CATALOG

DEPT. 10-P 1020 W. WILSHIRE BLVD., OKLAHOMA CITY, OK 73116

CIRCLE NO. 43 ON FREE INFORMATION CARD

Put Professional Knowledge and a COLLEGE DEGREE in your Electronics Career through

HOME STUDY



Earn Your DEGREE

by correspondence, while continuing your present job. No commuting to class. Study at your own pace. Learn from complete and explicit lesson materials, with additional assistance from our home-study instructors. Advance as fast as you wish, but take all the time you need to master each topic. Profit from, and enjoy, the advantages of directed but self-paced home study.

The Grantham electronics degree program begins with basics, leads first to the A.S.E.T. degree, and then to the B.S.E.E. degree. Our free bulletin gives complete details of the program itself, the degrees awarded, the requirements for each degree, and how to enroll. Write for *Bulletin E-77*.

Grantham College of Engineering

2000 Stoner Avenue

P. O. Box 25992

Los Angeles, CA 90025

Worldwide Career Training thru Home Study

the tonearm, is an antiskating dial that has separate scales for conical, elliptical, and CD-4 styli. The cueing lever raises and lowers the pickup with a slow, damped motion in both directions. A small knob can be set to play a record only once or to repeat it indefinitely until the player is manually shut off.

The operation of the record player is initiated and controlled by a single lever near the front of the motorboard. When moved to START, it turns on the motor and causes the pickup to index to the lead-in groove of a 12" (30.5-cm) record if the player is set for 33 $\frac{1}{3}$ rpm. When the 45 rpm speed is selected, the tonearm indexes to a 7" (17.8 cm) diameter. After playing the record, the pickup automatically returns to its restpost and the motor shuts off. This action can be initiated at any time by moving the control lever to STOP. Alternatively, the pickup can be lifted from its rest by hand, which starts the motor, and placed on the record manually.

For multiple play operation, the short single play spindle, which rotates with the record, is removed and replaced with the multiple-play spindle supplied. Up to six records of the same size and speed can be loaded and will be played automatically and in sequence.

The 3-pound (1.3-kg) cast nonferrous platter is driven through a soft belt by an eight-pole (900-rpm) synchronous motor. The speed selector, located at the left front of the platter, shifts the belt to a different diameter of the pulley on the motor shaft, and a concentric knob expands the pulley slightly to vary each speed over a nominal $\pm 3\%$ range.

A single ring of stroboscope marks is cast into the edge of the platter, with an unconventional pattern that allows a single set of markings to be used with either 50- or 60-Hz power sources. (The drive pulley must be changed to match the line frequency). The marks are illuminated through a small window near the edge of the platter and are stationary only when the turntable is operating at 33 $\frac{1}{3}$ rpm when that speed has been accurately set. Switching to 45 rpm will also produce the correct speed.

Laboratory Measurements. The record player uses the same easily removable cartridge mount that has been part of every Dual record player for a number of years. We installed a Pickering Model XV-15/750E cartridge in the tonearm for our tests. With the arm balanced according to instructions, the calibrations of the tracking force dial were exact. The tracking error of the tonearm

was less than 0.4° per in. of radius at all playing diameters. The measured arm mass without cartridge was 19.4 grams, which is typical of the better automatic record players we have tested recently. The resonance of the tonearm mass and cartridge compliance combination was at 10 Hz, at an amplitude of 6 to 7 dB.

The unweighted rumble of the turntable was typical of medium-priced belt-driven record players, measuring -32 dB, essentially all in the lateral plane. With ARLI audibility weighting, the rumble was -53 dB, which is also a satisfactory and typical figure for a player of this type and price range. The wow and flutter were respectively 0.03% and 0.04%, giving a very good combined reading of 0.045%.

The turntable speed could be varied over a +5.5% to -4.7% range at 33 $\frac{1}{3}$ rpm. When it was set to exact speed, changing the speed selector to 45 rpm resulted in a negligible error of 0.2%. At 45 rpm, the turntable could be varied over a +2.4% to -1.3% range. The speed was unaffected by line voltage changes from 95 to 135 volts.

The calibration of the antiskating dial was reasonably accurate, although we found the best compensation, to produce equal distortion on both channels, occurred when the dial was set 0.5 to 1 gram higher than the tracking force. The cueing device operated with exceptional smoothness and freedom from lateral pickup drift. In multiple-play operation, the change cycle required 14 seconds, a typical figure for record changers. However, automatic single-play operation required considerable patience on the part of the user, since it took 16 seconds from the time the lever was moved to START to the time the pickup touched the record. At the end of play, another 14 seconds was required to return the arm to its rest and shut off the motor.

The capacitance to ground of the tonearm wiring and signal cables was 168 pF/channel. Although the manual states that the record player is compatible with CD-4 cartridges, it evidently refers only to the internal wiring of the tonearm. A special low-capacitance cable should be obtained from the importer (United Audio) and substituted for the standard cable if CD-4 operation is planned for the future.

The entire record player is suspended from its mounting base by soft spring mounts, which proved to be very effective in isolating it from subsonic vibration conducted through the mounting surface. In fact, the entire unit could be jarred rather violently without causing

groove jumping. However, the transmission of vibration in the region of 50 to 60 Hz was observable. It was about the same as we have measured on other record players from Dual and most competitive manufacturers. Hence, the Model 1245 should not be placed too near speakers systems to avoid acoustic feedback problems.

User Comment. Because of the continuity of basic design and performance that has characterized Dual products over the years, we noted little difference in operation between the Model 1245 and earlier Dual record players we have tested and used. It is not necessary to make comparisons between the measured performance of the Model 1245 and its predecessors to appraise its worth. The Model 1245 is a first-rate record player, judged objectively on its own

merits. It was also mechanically one of the quietest automatic record players we have used.

The convenience of buying an almost ready-to-play package such as this cannot be overstated. Many record players, including some previous Dual models, required the removal of numerous screws, cable ties, and plastic shipping restraints before the player mechanism could be installed on its base. Then, the belt (if it was a belt-driven unit) and platter had to be installed. Finally, after installing and adjusting the cartridge, cover, and cables, the record player was ready for use.

When the Model 1245 is unpacked, only the installation of the cartridge and the counterweight is needed to put it into service. Of course, there is still the balancing of the tonearm and the overhang adjustment of the cartridge position to

be done, but these apply to any record player that does not include a factory-installed cartridge. Dual makes these tasks as easy and foolproof as possible, and in our experience, when the directions are followed, the result is a properly set up record player.

We should point out, however, that the instruction manual lacks clear information on the channel orientation of the cartridge wiring and the color coding of the cartridge wires in the mounting slide. An illustration does show the cartridge connections; but with no clue as to whether it is a top or bottom view, there is only a 50% chance of the left-right channel orientation's being correct. (We were lucky in our guess.)

Aside from this minor inconsistency, the Dual Model 1245 is as good a record player as one can find in its price range.

CIRCLE NO. 102 ON FREE INFORMATION CARD

BURWEN MODEL DNF 1201A NOISE REDUCER

"Swishless" dynamic low-pass noise filter is very effective in reducing hiss.



The Burwen Model DNF 1201A dynamic low-pass filter is designed to reduce the high-frequency noise

(hiss) in any program with little or no effect on the audible frequency response. Unlike the Dolby and ANRS systems, it does not require that the program material be previously processed.

The Model DNF 1201A is basically similar to the Model DNF 1201 sold by Burwen before the company was acquired by KLH, but the time constants and other characteristics in the new model have been modified to make the filter more effective and less obtrusive. In the 1201A, the bandwidth of the filter varies between 500 and 30,000 Hz, depending on the level and frequency content of the program. The rated cutoff slope is 9 dB/octave.

The filter comes in a physically flat package that measures 17½"W × 8¼"D × 2⅞"H (44.5 × 21 × 7.3 cm) and weighs 8 lb (3.6 kg). The walnut finished wood cabinet is complemented by a silver-colored front panel. Nationally advertised retail value is \$379.

General Information. Like any "open-ended" noise reducing system, the Model DNF 1201A is faced with the seemingly impossible task of determining whether the high-frequency energy in the program is part of the recorded material or is noise. Having made the determination, the bandwidth of the filter must be reduced as much as possible without sacrificing the higher-frequency program components. The variation of the bandwidth must also be done at such a rate that it cannot be audibly detected by the listener. That this can be accomplished successfully is due to the phenomenon of "masking," which means that certain frequencies can be rendered inaudible by the presence of others, even though by themselves they can be plainly heard. Hence, the presence of the program is used to mask noise, leaving the filter with the task of removing the noise during quiet intervals in the program.

In the Model DNF 1201A, if the program has significant amounts of high-frequency energy, the bandwidth of the filter opens up to pass it. If there are no highs present, or if the overall level of the program drops, the bandwidth of the

filter reduces to decrease the noise. The four variables that control the operation of the Model DNF 1201A are the level and frequency distribution of the incoming signal and the attack and decay times (rates at which bandwidth increases and decreases).

Front-panel controls on the filter give the user considerable latitude in his selection of its operating parameters. Hence, the action of the filter can be optimized for any program. The basic operation of the filter is controlled by four pushbutton switches and a slide-type control. The buttons are labelled OFF, MAX, MED, and MIN. With the OFF button pressed, the incoming program bypasses all the circuitry in the filter and is delivered directly to the outputs. Operation of any of the three remaining buttons adjusts the manner in which the bandwidth controller circuit, which supplies the control voltage to the filter circuits, responds to signals of different frequency and attack times. MAX is used for very noisy programs, such as 78-rpm discs and poor quality broadcasts and tapes. It provides a slow response time to minimize the "swish" of noise that can accompany a rapid change in bandwidth with a noisy background. MED provides a shorter attack time, and MIN gives the fastest filter response and the least severe filter action, making it suitable for relatively high quality program material.

At low program signal levels, the bandwidth changes rather sedately, tracking the signal without introducing excessive background noise modulation. However, a sudden transient can open up the filter in as little as 600 μs.



DiscTraker™ —a revolutionary tonearm damper from Discwasher

DiscTraker is a precision damping device that improves the performance of tonearm/cartridge systems by adding a protective cushion between the record and the tracking stylus.

- reduces low frequency resonance that colors the sound of even the best tonearm/cartridge systems on all records.
- reduces record-warp resonance—as witnessed by a dramatic reduction of woofer flutter.
- permits accurate tracking of even badly warped records.
- reduces record wear and stylus damage from warps.
- reduces distortion caused by high velocity groove overload, mistracking and intermodulation.
- adaptable to most tonearms.

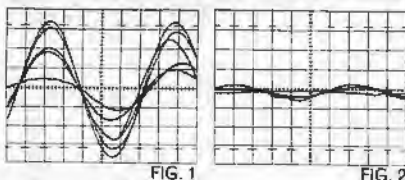


Figure 1 shows the amplitude of low frequency resonance in a typical tonearm/cartridge system using a "flat" record. Figure 2 shows the identical conditions with the DiscTraker damping system on the tonearm.



discwasher, inc.
1407 N. Providence Rd.
Columbia, Missouri 65201

The decay time, during which the bandwidth closes down, is determined by the dynamic characteristics of the program and can vary between 50 ms and 1.5 seconds.

Proper use of the SENSITIVITY slide control is vital to the successful operation of the filter. At its left limit is a red SUPPRESSION LED and at the right limit is a green WIDEBAND LED. The LED's glow in accordance with the instantaneous condition of the voltage controlled filter. When the green LED is on, the program passes with its full bandwidth; when the red LED is on, the bandwidth reduces. In use, the control is adjusted until the two LED's flash alternately or if the program is highly complex, until both LED's appear to be illuminated simultaneously.

The filter normally connects in the tape monitoring path of an amplifier or receiver. The tape recording input and output jacks are duplicated in the rear of the filter, activated by a pushbutton MONITOR switch on the front panel, so that none of the tape monitoring flexibility of the system is lost. In addition, there is a PRE/POST button that places the filter in the signal path either ahead of the tape recorder or in its playback output. This permits the program to be "de-noised" before it is recorded, and (if desired) again upon playback. In addition, other noise-reduction systems, such as Dolby or ANRS, can be used in the tape recorder itself.

The filter operates on both channels. Its control voltage is derived from a mixture of the two channels. This assures that there will not be any interchannel bandwidth variations.

The filter is a unity-gain device (screwdriver adjustment on the rear panel permits some variation about gain). It has nominal rating of 1 volt in/1 volt out. The filter can handle signal output levels up to 6 volts without distortion. The internal noise is rated at 100 μ V, or 80 dB below 1 volt. The total harmonic distortion (THD) is rated at less than 0.2%. The amount of noise reduction can be from 5 to 14 dB above 400 Hz, and as much as 30 dB above 5000 Hz.

Laboratory Measurements. Very few conventional measurements can be made on the Model DNF 1201A, because the presence of a test signal itself affects the filter bandwidth. At the factory, the dc control loop is opened and the filter characteristics are measured with an external control voltage.

We made frequency-response measurements with different signal levels at

a fixed setting of the SENSITIVITY control and at a fixed signal level with different settings of the SENSITIVITY control. The results in general confirmed the manufacturer's ratings. (Since they were static measurements, they did not reveal anything about the dynamic properties of the unit.) We noted, however, that although the "full-cut" filter response had the rated 9 dB/octave slope, beginning at about 500 Hz, when the filter was partially activated by the swept input signal the apparent slope was much steeper—about 24 dB/octave.

Distortion was measured with a 400-Hz input signal at a level of 1 volt. With the OUT button pressed, the THD was 0.014%. With full suppression (MAX) maximum distortion was only 0.11%. And when the SENSITIVITY control was moved to turn on the WIDEBAND LED, the THD was only 0.031%.

User Comment. Since the measurements we were able to perform can do little more than suggest the performance of the filter, we depended largely on use tests for its evaluation.

We tested one of the original Burwen Model 1201 filters several years ago and found a tendency for a noise "swish" to be audible. Thus, we were curious to learn if this problem had been solved in the 1201A. It has! Only by the most obvious misuse of the new filter, on very hissy programs, could a swish be heard. Such incorrect operation of the filter is unlikely in practice, since its controls are meant to be adjusted to provide the maximum possible noise reduction without unacceptable side effects.

When the two LED's flashed alternately, the filter operation was almost never detectable, but the hiss reduction was quite impressive. Like any open-ended noise reduction system we have used, the technique employed by Burwen is most effective with a relatively noise-free program. But though a good, quiet program might seem to be an unlikely candidate for noise reduction, the filter can usually convert it from merely quiet to dead silent.

Neither did the 1201A produce any dulling of the highest frequencies when properly adjusted. Here, too, the end result is under the user's control.

In conclusion, we feel that Burwen has proved the worth of its basic concept. The redesigned filter has eliminated all of our former reservations about the original filter. In its present form, the DNF 1201A is a highly useful adjunct to any good music system.

CIRCLE NO. 103 ON FREE INFORMATION CARD

Up your organization.



The Basic Box (left) and the Peripheral Plate.

With no-nonsense organizers from the Digital Group.

Not so long ago, the microcomputer domain belonged to a special group of creative, inventive folks — the inveterate hardware hackers who delighted in making a thing work and didn't really care all that much about how it looked.

The Digital Group was a part of it. Our original microprocessor systems were designed not to require any cabinets at all — they simply worked well.

Of course, along the line we couldn't resist making a good thing look good too . . . and we added our complete line of custom, deluxe cabinets to cover up.

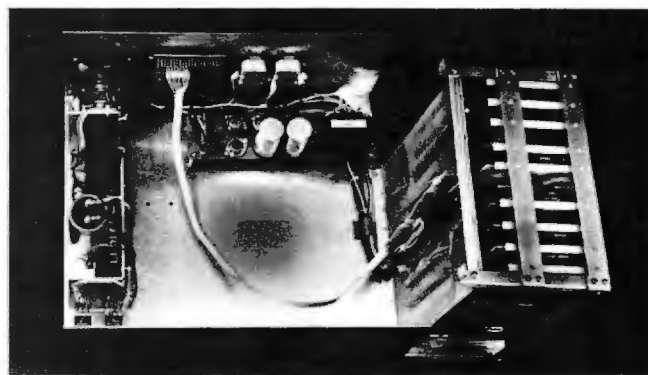
Well, we haven't forgotten those no-nonsense computer builders who just want a way to organize their systems. So the Digital Group has taken a step back to come up with a basic answer: The Organizers — the *Basic Box* and the *Peripheral Plate*.

Beautifully simple. No paint. No anodizing. No frills. Just exactly what you need.

The *Basic Box* houses your CPU, power supplies, fan, switches and I/O connectors in one tight little 16" by 17" package. It's available completely naked — a metal box with a card rack so you can add to it from your own parts supply; or we'll spiff it up for you with optional equipment.

The *Peripheral Plate* is a piece of bent metal with room for your keyboard, video monitor, two Phi-

decks or an audio cassette recorder. All at your fingertips. For organization.



Card rack swings out for service.

Naturally, our basics have down-to-earth prices, too. The *Peripheral Plate* is a mere \$19.50 . . . the basic *Basic Box* goes for \$45 (a little more depending on options).

Want to up your organization? It's simple. Just call or write the Digital Group for details.

the digital group

P.O. Box 6528 • Denver, Colorado 80206
(303) 777-7133

THE SOURCE OF PERFECTION IN RECORD PROTECTION!



Why take a chance?

Why accept counterfeits in place of Genuine Pickering Replacement Styli?


No other manufacturer is licensed to copy or duplicate the genuine Pickering product: Bogus styli made by others can't be very good because they were created by "reverse engineering" . . . meaning, of course, that attempts to copy the exacting dimensional tolerances can only approximate the original.

Here are some things to remember:

1. A Pickering cartridge is a precision instrument. A genuine Pickering replacement stylus assures a proper fit and perfect performance.

2. The attempts of others to duplicate the genuine product are by definition illegitimate and/or illegal, and probably won't work up to expectations.

3. The Dustamatic Brush, which cleans the record's grooves in advance of the stylus, is also covered by Patents issued only to Pickering.

4. Always look for the  on the stylus handle. It identifies the genuine Pickering replacement stylus.

Genuine Pickering Replacement Styli are covered by one or more of the following patents: Patent #3146319; 3297831; 3546399; 3572725.

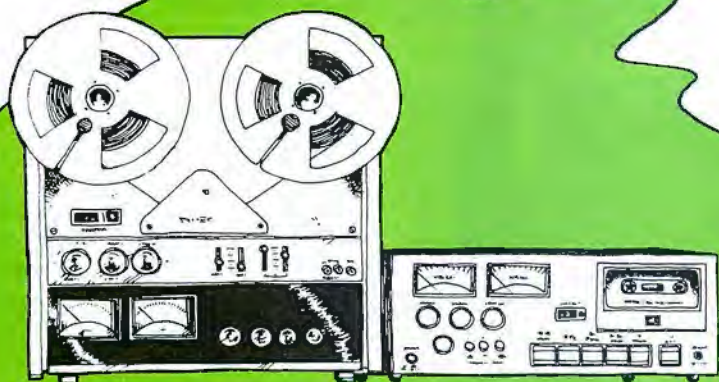
PICKERING & CO., INC., COPYRIGHT 1977

For further information write to Pickering & Co., Inc., Dept. PE 101 Sunnyside Blvd., Plainview, N. Y. 11803

A GENUINE  **PICKERING** REPLACEMENT STYLUS

"for those who can [hear] the difference"





BUILD AN AUDIO COMPANDER

*Provides greater dynamic range
and reduces noise.*

BY JOHN ROBERTS

PERHAPS the last frontier yet to be crossed by high-fidelity program sources is dynamic range. For example, the best consumer tape decks have a dynamic range of about 65 dB when used with premium tape formulas. Compare that to the 115-dB range of music produced by a symphonic orchestra at a live performance.

This project—a 2:1/1:2 compander—will allow you to record live music on your existing tape deck and later play it back without losing its original dynamic range. Other benefits of compansion are

increased tape headroom during record and noise reduction during playback. These advantages can be realized whether the program material is being recorded live or transcribed from another format. The compander is easy to build and use, employs a new Signetics IC, and has a low parts count. A stereo compander is available in kit form as described in the Parts List.

Compansion involves compressing a signal's amplitude before it is committed to the recording medium, and then ex-

panding it in a complementary fashion when it is recovered. This is typically accomplished by inserting a fixed-slope (2:1) compressor in the signal path before the tape deck's record preamp and a fixed-slope (1:2) expander at the output of the deck's playback preamp. The process is shown graphically in Fig. 1. Practicalities of electronic circuitry in preamps and power amplifiers limit their dynamic range to 100 to 120 dB. However, this approaches the dynamic range of live music and (comfortable) human hearing, easily attainable by a good tape deck working with a 2:1/1:2 compander.

The improvement in S/N becomes apparent when we look at a specific example. Let's assume that we have a tape deck with a noise floor of -45 dBm and that we want to record a piece of music with passages as low as -50 dBm. In the absence of any processing, the soft passages would disappear into the hiss. However, if we pass the signal through a 2:1 compressor before recording it, the minimum amplitude recorded is -25 dBm, a full 20 dB above the noise. On playback, passing the tape output through a 1:2 expander restores the -25-dBm signal to its original -50 dBm. Simultaneously, the noise drops by the same -25 dB to -70 dBm.

Improvements are also realized in the upward direction. That is, headroom is increased. A tape that previously saturated (causing distortion) at +10 dBm can now handle a +20-dBm signal at the compressor input. Although compansion increases S/N and headroom, it places more stringent requirements on the medium's frequency response and amplitude stability. Because the expander's gain depends on the level of the compressed signal applied to it, any amplitude errors will be magnified. In the case of a 2:1/1:2 compander, any frequency response errors or amplitude anomalies will be doubled.

A Compander IC. Signetics Corporation has recently developed an IC called the NE570. It is a dual-channel linear IC, and either section can be used independently of the other as a compressor or expander. A block diagram and pinout of the NE570 is shown in Fig.

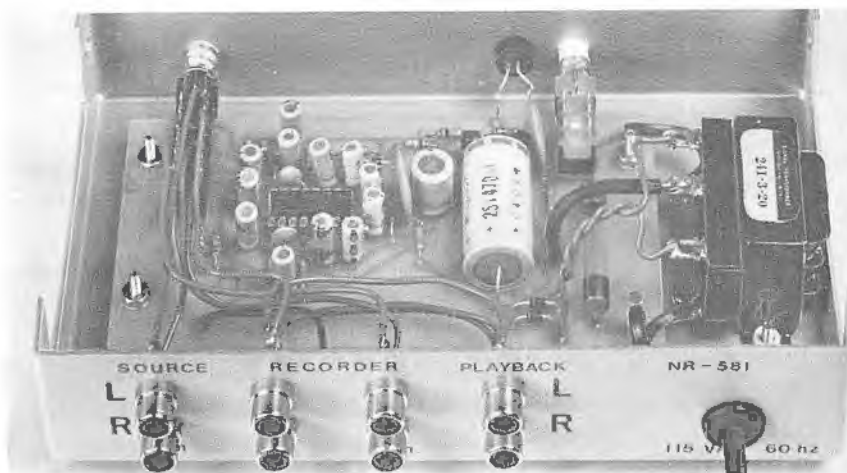


Photo shows prototype assembled on pc board and mounted in metal chassis.

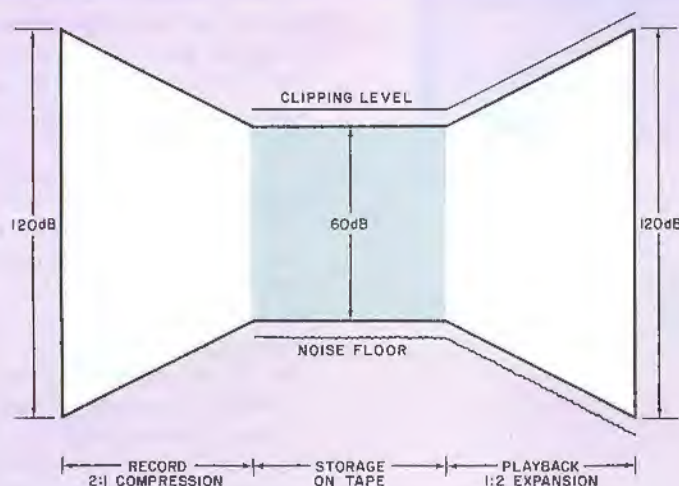


Fig. 1. Compression is used during recording, expansion on playback.

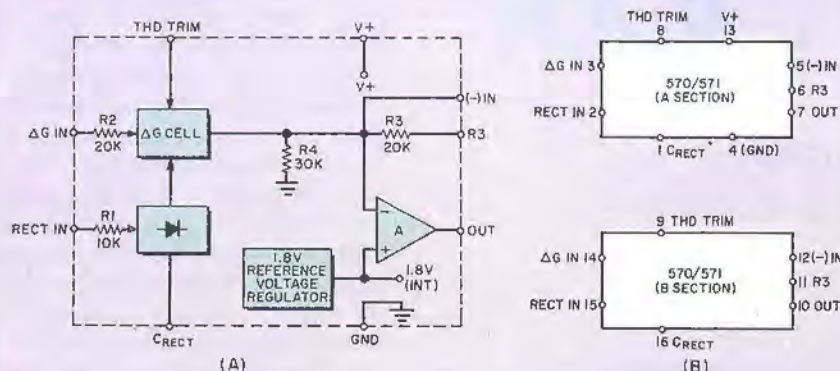


Fig. 2. Block diagram (A) and pinout (B) of the NE570 IC.

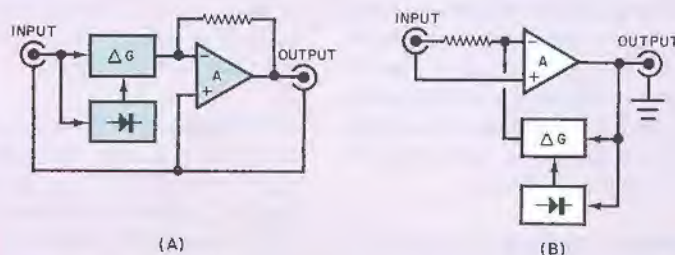


Fig. 3. Using the NE570 as an expander (A) and compressor (B).

2. Packaged in a 16-pin DIP, only the power supply and ground connections and an internal 1.8-volt bias regulator are shared by the two companders.

Each compander comprises a ΔG (variable gain) cell, a full-wave rectifier, and an output amplifier. The ΔG cell governs compander gain. Its control voltage is developed by rectifying an input signal. The output signal is generated by the op amp, which is driven by a scaled current supplied by the ΔG cell. Whether a section of the NE570 functions as a compressor or expander depends on how the basic blocks are interconnected. Typical specifications for the NE570 are in table on next page.

A 1:2 dynamic range expander (Fig. 3A) is formed by placing the ΔG cell at the input of the op amp. Its control signal is generated by sampling the input signal, rectifying and filtering it. The fixed feedback impedance sets the overall gain at unity when the input signal is 0 dBm or 0.775 volt. As the input increases or decreases from this level, the gain increases or decreases proportionally. For example, if the input level increases by a factor of two (+6 dB), the output level is quadrupled (+12 dB). If the input decreases by one half (-6 dB), the output drops to one quarter (-12 dB) of its previous value.

Rearranging the blocks to form the network shown in Fig. 3B results in a 2:1 dynamic range compressor. Here, the ΔG cell is connected as a feedback impedance, and its control signal is derived from the op amp output. The fixed input network sets overall gain at unity for a 0-dBm signal. If the input signal level increases by a factor of four (+12 dB), the output amplitude is doubled (+6 dB). If the input amplitude is decreased by a factor of four (-12 dB), the output signal decreases by a factor of two (-6 dB).

About the Circuit. The schematic diagram of the compander is shown in Fig. 4. A conventional full-wave rectifier and RC filter supply the required operating voltages. Note that only one compander channel is shown. The components with the suffix "A" are for the channel A compander only. Integrated circuit pin numbers in parenthesis are the corresponding inputs and outputs of the channel B compander. For example, pin 1 is connected to C4A, and pin 16 should be connected to C4B.

Diodes D3 and D4, LED1, transistors Q1 and Q2, and their associated components form a level indicator. The LED glows when input signal peaks exceed 0 dBm. Switch S2 interconnects the

TYPICAL SPECIFICATIONS NE570 COMPANDER

Maximum input/output level:	+12 dBm
Maximum output current:	±20 mA
Unity gain level:	0 dBm ±1 dB
Tracking error:	±0.2 dB
Gain change with temperature (0° to 70° C):	±0.1 dB
Output slew rate:	±0.5 V/μs
THD* (compressor or expander only):	0.3%
Expander noise output (measured with input shorted):	-96 dBm "A" weighting
Frequency response;	
Compressor:	20 to 20,000 Hz, +0, -1.5 dB at 0 dBm
Expander:	20 to 20,000 Hz, +0.5, -1 dB at 0 dBm

*—Harmonic distortion is caused primarily by ΔG cell offsets and modulation of the cell by control voltage ripple. When the recorded signal is expanded by the same ΔG cell that compressed it, the distortion cancels out, leaving tape noise or tape distortion dominant. Note—a phase inversion in the record/playback path will affect the accuracy of this cancellation.

blocks of each section of the NE570 so that the IC functions as a compressor on record and an expander on playback. Pulsating dc from the full-wave rectifier is smoothed into the ΔG cell's control signal by capacitor C4A. Capacitors C5A, C6A, C8A, and C9A provide ac coupling between various parts of the compander circuit.

Construction. The compander is best assembled using a printed circuit board. Suitable etching and drilling and parts placement guides are shown in Fig. 5. When mounting electrolytic capacitors and semiconductors, be sure to observe polarity and pin basing. An IC socket or Molex Soldercons are preferable to soldering the compander IC directly to the circuit board. Use the minimum amount

PARTS LIST

- C1—1000-μF, 25-volt axial-lead electrolytic capacitor
 C2—100-μF, 16-volt radial-lead electrolytic capacitor
 C3, C12—0.1-μF disc ceramic capacitor
 C4*, C5*, C8*—1-μF, 25-volt radial lead electrolytic capacitor
 C6*, C7*, C9*—10-μF, 16-volt radial lead electrolytic capacitor
 C10*—5-pF disc ceramic capacitor
 C11*—2700-pF disc ceramic capacitor
 D1, D2—1N4001 silicon diode
 D3, D4—1N914 silicon diode
 F1—½-ampere, fast-blow pigtail fuse
 IC1—NE570N compander
 J1* through J4*—RCA phono jack
 LED1—20-mA light emitting diode
 Q1, Q2—2N3904 npn silicon transistor
 The following are ¼-watt, 5% tolerance carbon composition resistors:
 R1, R2—750 ohms
 R3, R4, R5*, R6*—47,000 ohms
 R7, R8*, R9*, R10*—100,000 ohms
 R11, R12—1 megohm
 R13*, R14*—20,000 ohms
 R15*—120,000 ohms
 R16*, R17*—100 ohms
 S1—SPST switch
 S2—4PDT switch
 T1—34.5-volt, 50-mA center-tapped trans-

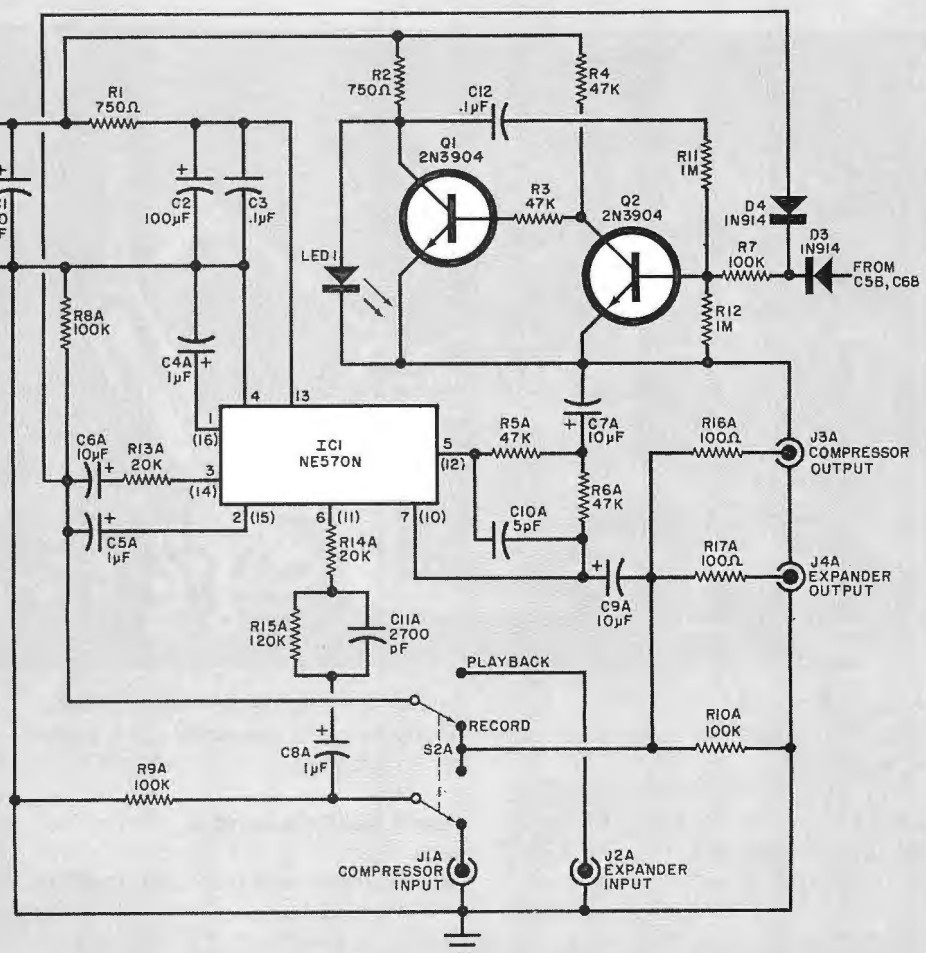


Fig. 4. In schematic of the compander, the "A" suffix is for one channel only. Duplicate components are needed for "B" channel.

former (Signal Transformer Co. No. 241-3-28 or equivalent)
 Misc.—Line cord, strain relief, suitable enclosure, hookup wire, printed circuit board, metal spacers, machine hardware, solder, etc.

Note—The following are available from Phoenix Systems, 375 Springhill Road, Monroe, CT 06468: complete kit of parts including

case (No. P-518-S), \$59.00; NE570N compander IC (No. P-518-C), \$12.50; power transformer T1 (No. P-518-T), \$5.00; etched and drilled pc board (No. P-518-B), \$4.50. Connecticut residents please add 7% sales tax. Canadians please add \$2.50 handling and shipping charges.

*—One component required for each compander channel.

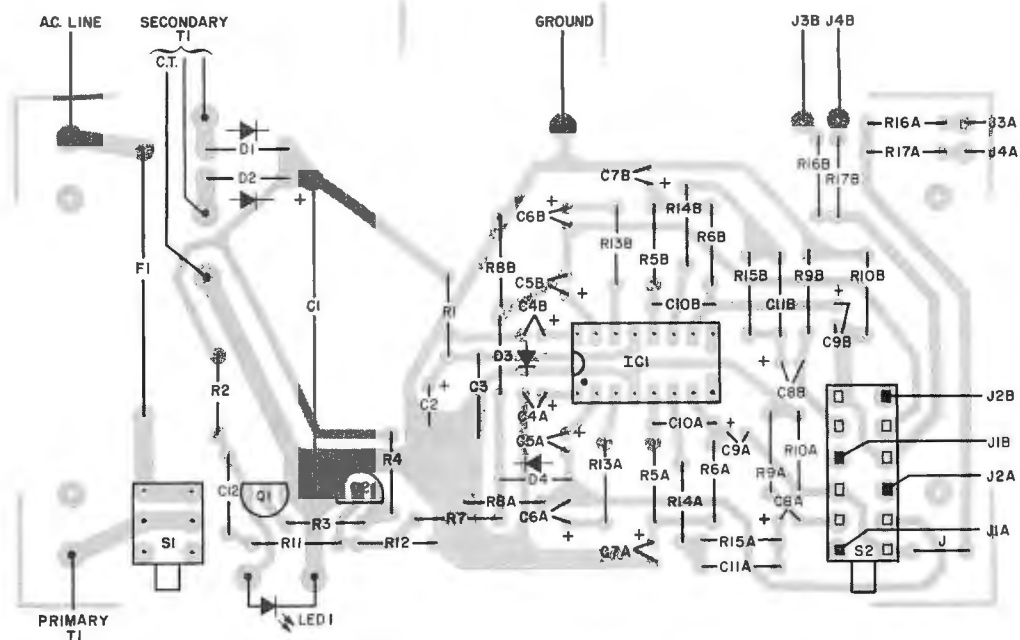
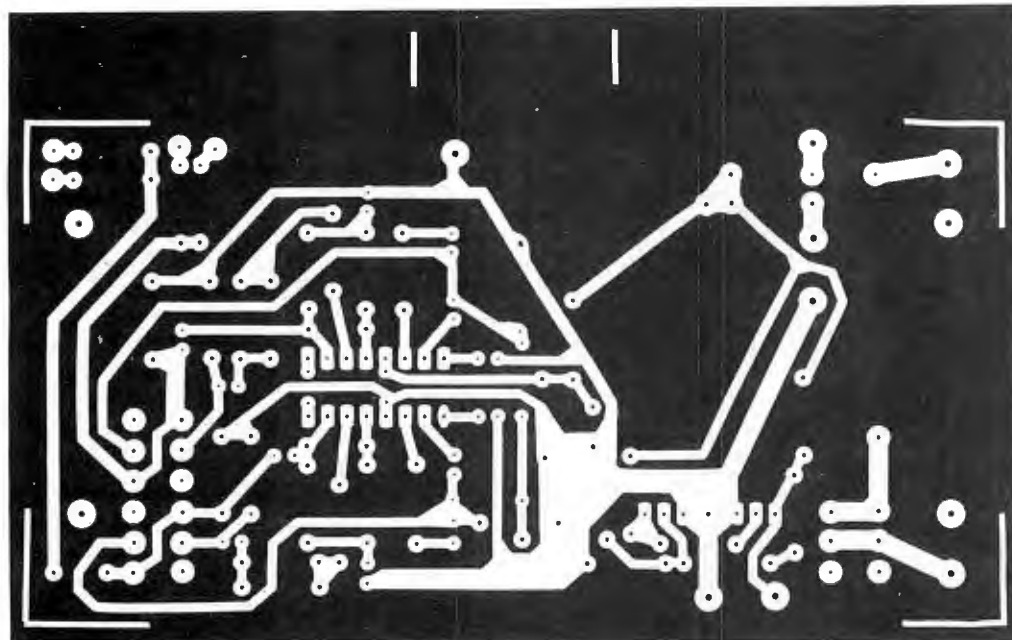


Fig. 5. Etching and drilling guide (left) and component placement (above) guides for the pc board.



of heat and solder consistent with the formation of good solder joints at each pc board pad.

If an alternate construction technique is used, care must be taken to keep all signal leads, especially those to switch S2, as short as possible. In any event,

the circuit should be mounted in a metal enclosure that is connected to the audio system ground.

Using the Componder, Interconnect each channel of the compander and your system's tape deck and amplifier

as shown in Fig. 6. Place S2 in the RECORD position and adjust the deck's record preamp level controls for a reasonable record level. With the added dynamic range supplied by the compander, you can afford to trade a few dB of the deck's S/N for reduced distortion levels. (Some tape machines are set to run very close to saturation to get the highest S/N possible.) Indicator LED1 is included not to alert you of clipping, but as an aid in setting record levels. The compander has at least 10 dB of headroom above the threshold at which the LED glows.

To play back a compressed tape, simply place S2 in the PLAYBACK position and put the deck in its playback mode. You will then retrieve the recorded program with its original dynamic range. ◇

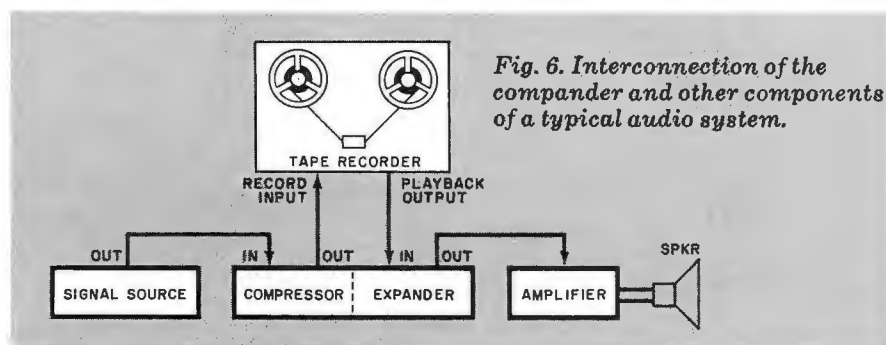


Fig. 6. Interconnection of the compander and other components of a typical audio system.



SELECTING THE BEST CASSETTE TAPE FOR YOUR RECORDING NEEDS

BY CRAIG STARK

IT'S not easy to pick the best cassette tape for your recording needs from the dozens of "name brands" and hundreds of unknowns on the market today. Naturally, there is some correlation between price and performance, reflected not only in the tape itself, but also in the plastic shell containers and their assembly. These can affect performance more than the differences between oxide formulations of the same type. But high price alone will not guarantee satisfaction if your tape deck has not been adjusted for the cassette you select.

Almost all high-fidelity cassette recorders have "bias and equalization" switches designed to accommodate at least two basic tape types: ferric oxide

and chromium dioxide. Unfortunately, there are at least *four* major cassette types on the market, and very few cassette decks have switch positions for all. Let's look at their characteristics.

Ferric Oxides. All pure gamma ferric oxide cassettes today use the same playback equalization (often identified as "120 microseconds"). In terms of their recording needs, however, they tend to fall into two different categories. The first are tapes designed to use "standard," "LN," or "DIN" bias, and include almost all American and European ferric oxides (e.g. 3M, Capitol, Ampex, BASF), as well as such Japanese tapes as Sony, Maxell LN, and TDK SD and

TDK D. This is the largest group of ferric oxides, and includes all quality levels.

The other major ferric group is designed to use about 5% to 10% more record bias current than the DIN standard. This group consists almost entirely of premium-quality Japanese tapes (Maxell UD and UD XL I, TDK AD, Nakamichi, and Fuji FX and FL). A recorder that is properly biased for a tape in this latter group will be over-biased for tapes requiring DIN-standard bias, while recorders set up for DIN-standard tapes will be under-biased for Japanese tapes in the "high-bias" group. Figure 1 shows the effects of such mismatching.

Under-biased tapes have exaggerated treble response; over-biased ones

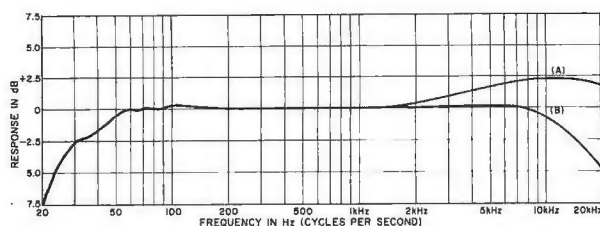


Fig. 1. Results of improper bias vary: (A) DIN bias settings used with typical Japanese ferric tape over-emphasize highs due to underbiasing. (B) Correct bias for same tapes over-biases DIN ferric tapes.

suffer unnecessary treble loss. If you've found the upper frequencies a little "soft" when using a top-quality domestic or European cassette tape on a high-priced Japanese deck, or found the treble too "hot" when using Japanese tapes on European or U.S. recorders, mismatched bias is almost certainly the reason. And while there are many fine tapes in the DIN group, the trend is toward higher-bias ferrics.

Chromium Dioxide. All CrO₂ cassettes use a "70-microsecond" playback equalization curve, which provides about 4.5 dB less treble boost in playback than the 120-microsecond equalization used for ferric oxides. This is made possible by CrO₂'s inherently greater treble output. The decreased treble boost makes possible, in turn, a 4.5-dB reduction in tape hiss.

However, this distinct advantage is partially offset by CrO₂'s lower output in the rest of the frequency range, as well as higher distortion levels compared to the performance of top-grade ferrics. A better known CrO₂ disadvantage—rapid head wear—is actually a myth at cassette speeds and pressures. Believe it only when you find someone who has actually worn out a cassette head using any kind of tape.

Ferrichrome. When ferrichrome cassettes were introduced several years ago, they seemed to offer the best of both worlds: high overall output (provided by a relatively thick layer of ferric oxide) and abundant high-frequency energy (provided by a thin, top layer of CrO₂). The drawback is that there is no standard for ferrichrome; Sony and 3M make radically different FeCr tapes. So even when a recorder has a "ferrichrome" switch position, the only way to find which tape it matches is to consult the instruction book. To add to the confusion, some machine makers recommend that you record ferrichromes with "ferric" bias and equalization and

"chrome" playback, while others recommend exactly the opposite. (Neither is really optimum.) Nonetheless, when ferrichrome tapes are correctly biased and equalized, they yield spectacularly good results, as the test section of this survey shows.

Cobalt-Treated Ferrics. Another attempt to combine the virtues of two different magnetic materials is represented by the cobalt-treated (or "cobalt-doped") ferric oxides. Here, the two materials are not layered, as ferrichromes are. Instead, each ferric oxide particle is enriched with cobalt ions through a complex molecular-binding process. The result is a tape with much greater overall output than chrome, but with equal high-frequency energy. These new tapes also take advantage of the standard bias and equalization settings used for chrome tapes; that's why they're referred to in our test table as "CrO₂-equivalent" ferrics. TDK's SA ("Super Avilyn") was the first of these tapes, and was followed by Nakamichi SX and Maxell UD XL-II. (3M's Master II is

another tape in this category, but was not available for test at this writing.)

What Makes a Tape "New and Improved?" Improvements to a tape's performance can take many forms. Two of them are shown in Fig. 2a and b. Figure 2a shows the frequency response of Maxell's now-venerable UD and its new UD XL-I, both recorded with the same signal. Both tapes have the same frequency response, but the higher curve for the UD XL I indicates greater output at all points in the audio spectrum—with a correspondingly improved signal-to-noise ratio.

A second kind of improvement, and one you're likely to see more and more of these days, is an increase in tape coercivity. This raises high-frequency response, as illustrated by the output-vs-frequency curves of Fig. 2b (which compares TDK's older Audua with its brand new "AD" tape). This rising high-end response can be accepted as a "brighter" sound, if you prefer, but it's really intended to be traded off for other benefits. Decks with adjustable equalization and bias let you trade it off for reduced distortion and a slight reduction in noise by diminishing treble boost in the recording. Also, the rising high end can compensate for the drooping treble of an inexpensive system's speakers. (It won't compensate for playback-head limitations, though.) In other stereo systems, turning down your amplifier's treble control will at one stroke restore proper frequency balance and reduce audible tape hiss.

Test Results. The results obtainable

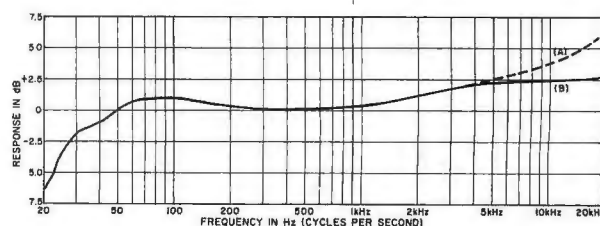
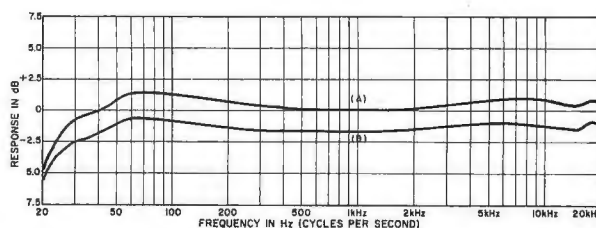


Fig. 2a and b. In (a), at top, Maxell gave its new UD XL-I tape (A) more output than older UD (B), but same response. In (b), below, new TDK AD tape has more high-end response (A) than earlier Audua (B).

CASSETTE TAPE TEST RESULTS

	Sensitivity: (333 Hz "0 VU")	Distortion: (3rd Harm. Dolby level)	Maximum Output: (3% HD 333 Hz)	Signal-to-Noise Ratio Unweighted Weighted	Saturation: (db below "0 VU" 10kHz)	Frequency Response (see text for code)
DIN bias ferrics						
DIN Std. cass.	±0.0	0.44%	+2.5	51.3	52.9	-11.2 A
Ampex 20/20+	±0.0	0.32%	+4.1	53.0	55.3	-12.8 B
Ampex Plus	+0.4	0.39%	+4.6	53.4	55.2	-11.3 A
Ampex 370	-1.8	2.35%	-0.8	49.0	50.9	-18.2 D
BASF Studio	±0.0	0.38%	+4.4	53.4	55.7	-13.3 B
BASF Performance	-1.8	1.22%	+1.1	50.3	53.0	-14.5 C
Capitol "Music"	+0.5	0.25%	+3.9	52.8	55.4	-13.6 B
Capitol 1	-1.1	1.9 %	+0.4	49.3	51.2	-19.8 D
Memorex MRX ₂	-0.7	1.2 %	+0.8	49.7	52.1	-11.6 A
Maxell LN	-1.8	1.95%	-0.1	48.8	50.9	-14.5 B
Scotch Master I	+0.1	0.6 %	+2.8	51.9	54.2	-10.2 A
Scotch LN/HD	-0.6	1.75%	+1.2	50.4	52.9	-13.8 D
Scotch Highlander	-1.1	1.65%	+0.4	49.5	52.0	-17.5 D
Sony UHF	-0.5	0.72%	+2.7	51.4	53.3	-10.1 A
Sony Plus 2	-2.3	2.28%	-0.7	48.1	50.2	-13.0 B
TDK SD	-0.9	0.65%	+2.8	51.7	53.6	-12.8 C
TDK D	-0.5	0.8 %	+1.6	50.1	51.4	-12.5 B
"High" bias ferrics						
Fuji FX	-0.1	0.28%	+4.0	52.4	53.4	- 9.8 A
Fuji FL	-2.4	2.5 %	-1.7	47.9	49.9	-12.8 C
Maxell UD	-0.8	1.1 %	+2.5	51.1	52.8	-10.4 A
Maxell UD XL-I	+1.0	0.35%	+6.1	54.7	56.3	- 9.8 A
Nakamichi EX	-0.6	0.74%	+2.6	51.2	52.8	-10.2 A
Nakamichi EX-II	+0.9	0.28%	+5.7	54.3	55.8	-10.2 A
TDK Audua	-0.8	1.15%	+1.5	49.7	50.7	- 8.7 Ar
TDK "AD"	-0.7	0.37%	+3.7	52.4	54.2	- 7.2 Ar
CrO₂						
BASF CrO ₂	-1.5	1.9 %	+0.2	52.6	54.8	- 9.2 A
Capitol CrO ₂	-1.0	1.85%	+0.2	52.6	54.6	-10.5 A
Fuji FC	-1.4	2.2 %	-0.2	52.4	55.5	-10.5 A
Memorex CrO ₂	-2.2	3.2 %	-2.1	50.3	52.5	-11.5 B
Scotch Chrome	-1.9	2.4 %	-0.8	51.9	54.4	-11.1 B
Sony CrO ₂	-1.9	2.45%	-0.7	51.5	53.3	- 8.4 Ar
CrO₂ Equivalent ferrics						
Maxell UD XL-II	+1.9	0.6 %	+4.0	55.6	57.4	- 8.2 A
Nakamichi SX	+1.3	0.85%	+2.8	54.5	55.7	- 8.7 A
TDK SA	+1.0	0.9 %	+2.3	53.7	55.6	- 8.8 B
FeCr bias & eq						
Scotch Master III	-1.7	0.45%	+4.9	57.2	59.4	-11.2 A
Sony FeCr	-2.6	0.71%	+3.2	55.5	57.5	- 9.4 A
Ferrichromes, DIN*						
Scotch Master III	+0.8	0.64%	+3.0	51.8	53.9	- 6.5 *
Sony FeCr	-1.2	1.52%	+1.2	49.8	52.2	- 5.4 *
Ferrichromes, "High"*						
Scotch Master III	+1.2	0.52%	+4.5%	53.2	55.5	- 6.8 *
Sony FeCr	-0.8	1.03%	+2.9	51.5	53.7	- 5.0 *

*Neither ferrichrome tape is designed for this bias/equalization, but it may be all the consumer has to use with them. Frequency response, however, rises from 1 kHz to 19 kHz, to between +10 and +12 dB.

from any tape depend as much upon the recorder and its settings as upon the tape itself. Differences between my test recorder and your recorder make it almost inevitable that the cassettes I tested would produce somewhat different results if tested on your deck. Where differences between tapes are small, a slight adjustment of bias or equalization can turn the scale in favor of one or the other. So ignore small differences in the

NOVEMBER 1977

results. Only the larger ones give grounds for definitely judging that one tape has a higher performance potential than another, regardless of the machine used.

Selecting a Tape. The test results here can be used as a starting point in selecting the right cassette for your own use. A glance at the table will reveal which tapes are of the same type as the

tapes your recorder's instructions recommend. The table will also help you weed out those tapes whose requirements differ significantly from that of the factory-recommended tape.

In the last analysis, the most significant tests are those you make on your own machine. To check frequency response for yourself, the interstation hiss from an FM tuner is an excellent and handy test signal. Record and play back

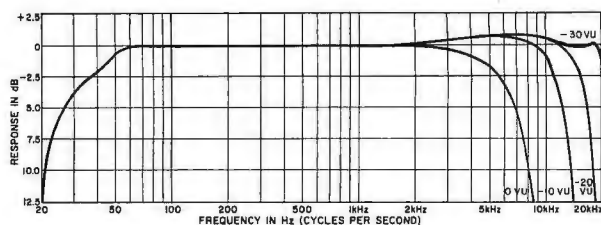
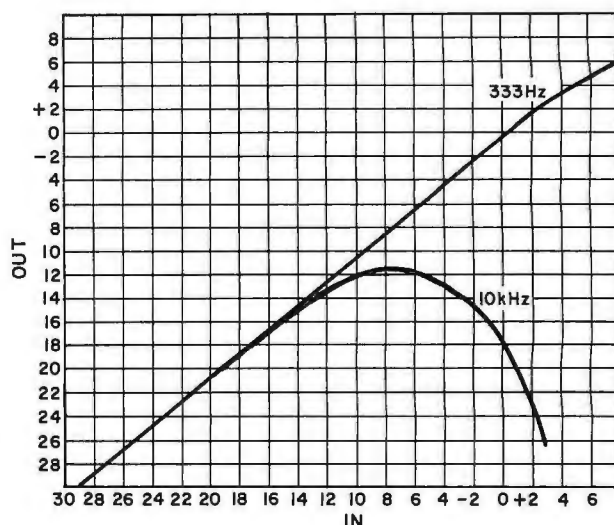


Fig. 3. Measured at low recording levels, modern cassettes are capable of extended frequency response.

Fig. 4. When saturation occurs, high-frequency output actually declines if the input signal increases further.



a few moments of it, flipping between "source" and "tape;" see which tape comes closest to matching the original sound. If you try this, however, remember to maintain the record level 10 to 20 dB below 0 VU on your recording meters. The high-frequency energy in the hiss signal would otherwise drive the

tape into saturation and thereby invalidate the test.

Note that the "best" cassette is not always the best choice for every application! As the results in the chart show, several low- and mid-priced tapes have been improved (some very recently) to the point where they can challenge the premium tapes for anything that doesn't require the full sizzle of a cymbal. But avoid cheap, unbranded cassettes, unless you really enjoy cleaning up the loose oxide they so often shed.

How to Interpret Test Results.

Because tape test results are so dependent upon the equipment used to make the tests, you won't find final full specifications listed for tape as often as you will for components. So, many of the specifications listed below will be unfamiliar, while others may seem unfamiliar in their current form. Here is what the numbers in our table mean:

Sensitivity: Here we compare the output of each tape with the output of the DIN Standard Blank test cassette, with each fed an identical input signal. This signal is a mid-frequency tone (333 Hz) of sufficient strength to record a magnetic flux level of 250 nanoWebers per meter on the DIN tape. This particular flux level, higher than the "0 VU" of most (but not all) home cassette decks, is an internationally accepted comparison level. All else being equal, the larger the number in this column, the better.

Distortion at Dolby Level: This is a comparison of the harmonic distortion levels of the various tapes at a standard level of recorded signal. Since tape-deck manufacturers are free to set their "0 VU" point at any level of recorded flux they choose, a measurement made at

any one deck's "0 VU" point would not be too meaningful. But as the "Dolby level" marks found on nearly every manufacturer's VU meters is a standard level (200 nWb/m), we used that as our reference point for this test. Since this is only 1.9 dB less than DIN "0 VU" level, it's at least *near* most manufacturers' "0 VU" markings.

The distortion levels may look lower than you're used to seeing for tape. That's because conventional "total harmonic distortion" meters measure everything that isn't signal—which includes not only all harmonics, but also hum and noise. Since the hum and noise on the tape are often greater than the distortion at this recording level, you will rarely see THD measurements of less than 1%. But since tape produces only odd harmonics, of which the 3rd harmonic is the lowest (and hence most prominent), a General Radio 1900-A Wave Analyzer was used to read only the tape's output at 999 Hz, the 3rd harmonic of the 333-Hz input signal.

Maximum Output Level: It is standard practice to consider a tape's Maximum Output Level (MOL) to be, for all practical purposes, the point at which its third harmonic distortion just reaches 3%. Beyond this level, moderate increases in input signal lead to very rapid increases in distortions. Consequently, saturation—at which point the tape's output will increase no further in spite of increases in input—is only a few dB away.

The number shown in this column is the "signal" part of each tape's signal-to-noise ratio, in decibels above the 250 nWb/m reference level. The higher the number, the better.

Unweighted S/N Ratio: This column indicates the ratio, in decibels, between

HOW TESTS WERE MADE

In making these tests, three C-60 samples of each cassette were checked, and an average of the two more similar samples is reported. In most cases, where the thickness of the oxide coating is the same, C-90 versions of the same tapes should perform essentially identically. Where a manufacturer chooses to use a thinner oxide layer in his long-play length, however, low-frequency sensitivity and distortion figures may suffer.

The tapes in this survey were tested on a new Technics RS-9900US cassette deck. In addition to its three-head design (a practical necessity where machine-run frequency response curves are to be made), this deck offers continuously variable bias and equalization controls on the front-panel, as well as the usual fixed bias and EQ switch positions. It would thus have been possible to "optimize" the deck for every tape tested; but since this would represent an unrealistic picture of the performance to be expected from typical home cassette decks, a practical compromise was employed. For the tapes listed in the charts as "DIN bias and equalization," the machine was optimized for the new DIN Standard Blank Cassette (TP 18 LHS), a special cassette made for test purposes. For the "high bias" Japanese ferrics, the deck was set up using Maxell UD XL-I. For CrO₂ and the cobalt-treated "chrome equivalent" ferrics, the set-up tape was Fuji FC.

the Maximum Output Level (MOL) of the tape and the output from a section of the tape which has been recorded with no input signal at all. The higher this number, the better, too.

Weighted S/N: Since the frequency response of the human ear at the low volume levels of tape noise is not "flat," a more meaningful measure of noise audibility is obtained by weighting its various frequency components according to the ear's sensitivity to each.

There are several weighting filters for this purpose. The most common is the NAB "A" weighting curve, which is derived from the famous Fletcher-Munson "equal-loudness" curves. More recent studies, however, suggest that a slightly different weighting curve, the CCIR curve, corresponds more closely to the perceived obtrusiveness of noise such as tape hiss. This weighting system, widely adopted abroad (and used by Dolby measurements of noise-reduction effectiveness), was used for our measurements in this column. The larger the number, the less perceptible tape hiss will be. This makes it a slightly more significant measure of tape performance than the unweighted S/N in the preceding column.

Saturation (10 kHz): Tape saturation level varies with signal frequency. At high frequencies, saturation occurs much earlier (Fig. 3). For this reason, and because the high-frequency content of most program material is far below the "0 VU" level, frequency response (next column) is usually measured at a level far below "0."

While dramatic in itself, Fig. 3 does not tell the whole story about high-frequency saturation. Although a tape's middle- and lower-frequency output will not increase past saturation even if input level increases, its high-frequency output actually *declines* when input levels are increased beyond the saturation point (Fig. 4).

Consequently, the figure shown in the "10-kHz Saturation" column represents the tape's absolute peak response and the onset of saturation. Distortion occurs long before this point (by about 10 dB), but is difficult to measure because the third harmonic generated (30 kHz) is outside the recorder's passband. The audible distortion products caused by high-end saturation are all too obvious, however, so the closer the negative number (in decibels below DIN "0" level) is to zero, the better.

Frequency Response: Individual frequency-response charts were made for each tape tested; but since the response patterns were so similar, they have been summarized in five categories here. An "A" curve indicates a response within ± 1 dB over the 100 to 20,000-Hz range. Three tapes (Sony CRO₂, TDK Audua, and TDK AD) showed a response that rose gradually above 1 kHz, reaching a maximum between +3 and +5 dB at approximately 19 kHz. Because, as explained previously, this may be looked upon as an advantage rather than as a defect, these tapes have been given an "Ar" (A, rising) denomination. Category "B" covers a span of ± 2 dB over the same range. With only minor adjustments of the bias and/or equalization, any of these tapes could have been made to show an "A" characteristic. Class "C" encompasses a ± 3 dB variation over the 100-to-20,000-Hz range, but would certainly be suitable for all but very critical applications. Class "D" tapes are definitely "limited performance" products whose response (even at the -30 VU test level employed on all the frequency response measurements) was typically down by about 5 decibels at 10 kilohertz. ◇

TIME KEEPING EXCELLENCE FROM DIGITAL CONCEPTS

TIME TUBES

ADD A NEW DIMENSION TO TIME ITSELF



A bright 0.5 Fluorescent display provides easy to read numbers that brighten and dim automatically according to the light. The acrylic tube with acrylic or hardwood ends gives these clocks a unique look of simple elegance. AM/PM & Power Failure Indicators. Alarm Models have easy to set beep alarm, snooze, and alarm set indicator. 3.5" X 3.5" X 5.75.

Complete Kits

CK-2001	Solid Clear Time Tube (shown)	\$39.95
CK-2002	Clear Tube with Walnut Ends	\$34.95
CK-2010	Solid Smoke Time Tube	\$42.95
CK-2012	Smoke Tube with Walnut Ends	\$36.95

All models available with alarm features. Add \$5.00 and specify "Alarm Version" and model number when ordering.

TIME CUBES

LEND AN ELEGANT EFFECT TO ANY HOME OR OFFICE



The 2020 Cube combines simplicity of design with the ultimate in technology. It features bright 0.5" fluorescent digits in a contemporary smoke and chrome enclosure. Includes AM/PM, Power Failure Indication, Easy set controls.

Model 2120 is same as above with pleasant beep alarm, photo electronic dimming system and alarm set indicator. It also features a 9-minute snooze which is activated by simply tipping the cube. Alarm on/off switch and "Tilt-Snooze" make wake up time easy to set. 4.5" X 4.5" X 4.7" High. Add to your collection with on-time designs from Digital Concepts.

Complete Kits

CK-2020	Smoke Time Cube	\$34.95
CK-2120	Smoke Time Cube with Alarm	\$39.95

Send your check or money order today for fast delivery. Add 5% to total order to cover shipping and insurance. Outside Continental U.S., add 10%. N.J. residents must also add 5% sales tax. Call (201) 845-7102 to charge your order to BankAmericard or Mastercharge.

- All clock kits are 100-120 VAC, 50/60 Hz.
- All models can be built for 12 or 24-hour format.
- We pay shipping and insurance within the Continental U.S. on orders over \$100.00.

245 ROUTE 46 SADDLE BROOK, N.J. 07662 (201) 845-7101

SYSTEM 5000

THE FULL FEATURE

PROGRAMMABLE CLOCK KIT



Have it *your* way with System 5000. After the circuit has been assembled, add the appropriate jumpers and switches to create a truly individualized time piece. There are enough features to satisfy the most discriminating enthusiasts. Build an Alarm/Clock/Calendar, full feature Desk, Computer Room, Radio Station Clock, or any combination to suit your tastes.

FEATURES

Time of day and duplicate time register, two 24-hour alarms, four year calendar, one hour down counter, and 10-minute snooze and ID timer; Direct-Drive 0.5" fluorescent panel with automatic brightness, PM and power failure indication; Forward or reverse time setting, 9-volt battery backup, seconds display on demand. Many more!

System 5000 includes all components, two test switches and complete instructions. 1.5" H. X 4" W. X 4" D.

Case not included. \$34.95

SYSTEM 5000 OPTIONS

RELAY OPTION—\$4.00 Includes 700 watt relay and interface to control appliances, stereos, etc.

SWITCH OPTION—\$3.75 Includes 4 SPST push buttons, 2 DPDT push buttons, and 2 SPST slide switches. Programs all major features.

QUARTZ TIME BASE—\$6.95 Generates precise 60 Hz. output with exceptional stability and accuracy. Direct interface to system 5000 and most other clocks. Includes all components and instructions.

CASE OPTION I—\$5.95 Includes simulated walnut cabinet, blue face plate, rear panel, and all mounting hardware. Ideal for many projects. 8.3" X 5" X 3.8".

CASE OPTION II—\$11.00 Deluxe hand finished, solid 3/8" walnut cabinet, complete with blue or green face plate and rear panel. 5.75" X 5.75" X 3.0".



digital concepts

SWTPC announces first dual minifloppy kit under \$1,000



Now SWTPC offers complete best-buy computer system with \$995 dual minifloppy, \$500 video terminal/monitor, \$395 4K computer.



\$995 MF-68 Dual Minifloppy

You need dual drives to get full benefits from a minifloppy. So we waited to offer a floppy until we could give you a dependable dual system at the right price.

The MF-68 is a complete top-quality minifloppy for your SWTPC Computer. The kit has controller, chassis, cover, power supply, cables, assembly instructions, two highly reliable Shugart drives, and a diskette with the Floppy Disk Operating System (FDOS) and disk BASIC. (A floppy is no better than its operating system, and the MF-68 has one of the best available.) An optional \$850 MF-6X kit expands the system to four drives.



\$500 Terminal/Monitor

The CT-64 terminal kit offers these premium features: 64-character lines, upper/lower case letters, switchable control character printing, word highlighting, full cursor control, 110-1200 Baud serial interface, and many others. Separately the CT-64 is \$325, the 12 MHz CT-VM monitor \$175.



\$395 4K 6800 Computer

The SWTPC 6800 comes complete with 4K memory, serial interface, power supply, chassis, famous Motorola MIKBUG® mini-operating system in read-only memory (ROM), and the most complete documentation with any computer kit. Our growing software library includes 4K and 8K BASIC (cassettes \$4.95 and \$9.95; paper tape \$10.00 and \$20.00). Extra memory, \$100/4K or \$250/8K.

Other SWTPC peripherals include \$250 PR-40 Alphanumeric Line Printer (40 characters/line, 5 x 7 dot matrix, 75 line/minute speed, compatible with our 6800 computer and MITS/IMSAI); \$79.50 AC-30 Cassette Interface System (writes/reads Kansas City standard tapes, controls two recorders, usable with other computers); and other peripherals now and to come.

Enclosed is:

- _____ \$1,990 for the full system shown above (MF-68 Minifloppy, CT-64 Terminal with CT-VM Monitor).
- _____ \$995 for the Dual Minifloppy
- _____ \$325 for the CT-64 Terminal
- _____ \$175 for the CT-VM Monitor
- _____ \$395 for the 4K 6800 Computer

- _____ \$250 for the PR-40 Line Printer
- _____ \$79.50 for AC-30 Cassette Interface
- _____ Additional 4K memory boards at \$100
- _____ Additional 8K memory boards at \$250
- _____ Or BAC # _____ Exp. Date _____
- _____ Or MC # _____ Exp. Date _____
- Name _____ Address _____
- City _____ State _____ Zip _____



Southwest Technical Products Corp.

219 W. Rhapsody, San Antonio, Texas 78216

London: Southwest Technical Products Co., Ltd.

Tokyo: Southwest Technical Products Corp./Japan

CIRCLE NO. 57 ON FREE INFORMATION CARD

IF YOU'RE like many electronics hobbyists, the projects you value most are the ones you built from scratch without using a kit. Unfortunately, they are also usually the projects that have an obviously home-made look. You probably look great pains to make the printed circuit boards "just so," and then had to make do with available utility boxes and panel marking equipment. The result is most likely a plain metal or wood-grain vinyl control panel with the controls and inputs and outputs labelled with a Dymo tape machine.

In this article, we will explore some techniques you can use to design and fabricate professional-looking panels that will do justice to your projects. With a little practice, these suggestions should have you designing and fabricating control panels that look every bit as good as those turned out by industrial designers for commercial products.

The Preliminaries. The best approach to designing control panels is to do the layout work at the same time you design the printed-circuit board. In fact, in many cases, it is often advantageous to do the control panel layout first and then design the circuit board accordingly. This is especially true if you are using pc-type switches and controls.

By designing the control panel and circuit board at the same time, you will have a good idea of the size and shape of the case in which to house your project, and you will know how much panel space will be required for the various controls, switches, jacks, indicators, etc. You will also be able to arrange the various panel-mounted items according to function, frequency of use, and size to present a visually pleasing appearance.

If your project requires electrical or r-f shielding or that the control panel serve as a ground conductor, you can use a sheet of soft aluminum for the panel. For the great majority of projects, however, the best material to use is acrylic plastic sheets that are easy to cut, drill, and shape with ordinary wood tools. White translucent acrylic with black lettering and graphics are a good choice. Of course, you can also use color-tinted transparent or translucent acrylic sheets with complementary-color lettering and graphics for special visual effects.

In this article, the emphasis is on acrylic plastic sheets for front panels. The sheets are available in thicknesses ranging from 3/16" (1.6 mm) on up, but the minimum recommended thickness for a front panel that measures up to 12" x 12" (30.5 x 30.5 cm) is 1/8" (3.2 mm).

You can use thicker sheets, but they are not necessary; they will also increase cutting, drilling, and shaping times.

Acrylic plastic sheets come with protective paper on both sides. Do not remove this paper until you have completed all drilling and cutting. The paper itself serves as convenient means for pencilling in all cutting and bending lines and drill-hole centers (Fig. 1). (If you must use an aluminum panel, it is a good idea to place over it a layer of protective masking tape. The tape also provides a convenient drawing surface, similar to that provided by the paper on the acrylic sheets.)

Preparing the Panel Surface. After your panel has been drilled and cut to size, peel off the protective paper. If it is a complicated panel, try to peel away the paper on which you drew the cutting lines and drill holes without tearing it so that you have a reference from which to work when it comes time to mount the various items on the panel.

pleasant to look at and is also free from oily residue.

Working Up a Panel Design. Part of your arsenal of tools for electronics work should be a minimum drafting instrument set that contains a ruling pen and an inking compass. To master the proper use of these tools, all you have to do is follow a few simple rules.

First, fill the pen with India ink using the filler/stopper that comes with the bottle to a depth of only 3/16" (4.8 mm). Next, use the thumbscrew on the side of the pen to adjust the width of the line. When you use the pen and a straightedge to draw lines, hold the pen flat against the straightedge and perpendicular to the surface of the panel as shown in Fig. 2. Finally, lean the pen slightly in the direction of the line you are drawing; 15° to 30° is sufficient (Fig. 3).

If you have never used a drafting pen or inking compass before, practice with them on paper and scrap acrylic sheet (surface finished as above) to get the

HOW TO DRESS UP YOUR PROJECTS

Tips on how to make your home-made equipment look professional.

BY ROBERT DEVOE

Sand the panel with very fine sandpaper. Sand in only one direction, preferably parallel to the long dimension, to give the surface of the panel a "tooth" for the lettering and graphics. Now scrub the sanded panel with steel wool and scouring powder, again working in only one direction. This scrubbing gives the panel a velvety matte finish that is

"feel" of the tools. Be sure to clean the pen and compass tips before each filling. Bear in mind that a light touch is all that is required when drawing ink lines with a drafting pen or compass. If you must press down, you are doing something wrong.

In addition to drafting tools, you should have on hand a dry-transfer let-

tering kit. There are generally two types of dry-transfer kits—the type that you cut out and stick down and the type that you rub down directly from the carrier sheet. The latter is recommended. Dry-transfer type can be obtained from art supply, office supply, and drafting equipment stores in a wide range of type styles, sizes, and colors. Some manufacturers of printed circuit materials also offer transfer sheets of electronic symbols, pc patterns, and control-labelling kits with commonly used legends.

When you use a dry-transfer lettering kit, do the following. First, draw a light pencil line on the panel about $\frac{1}{8}$ " away from the bottom of the letter line you want to produce, as shown in Fig. 4. You

Fig. 1. Protective paper on acrylic sheets is used to draw guidelines and dimensions.

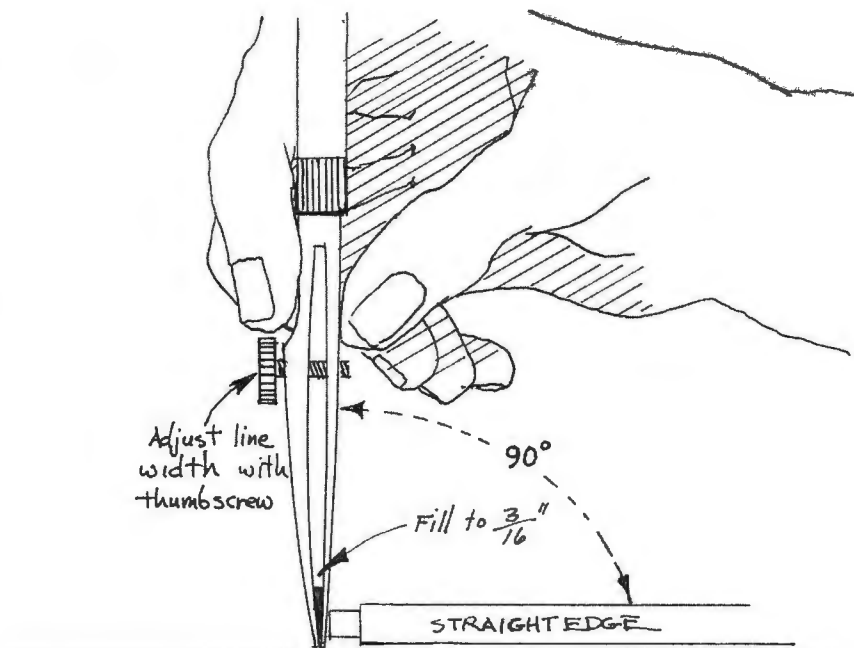
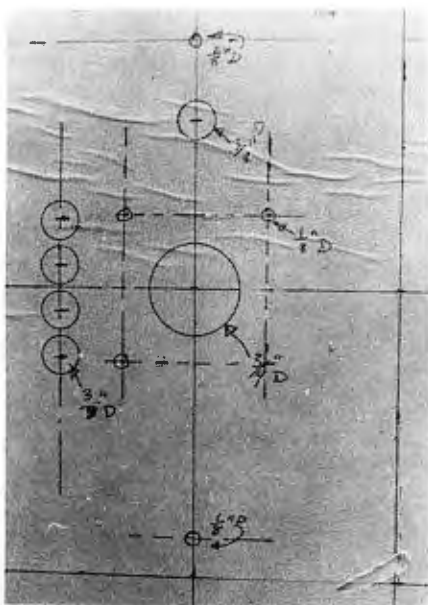


Fig. 2. When you use a pen and straightedge to draw lines, hold pen perpendicular to panel as shown here.

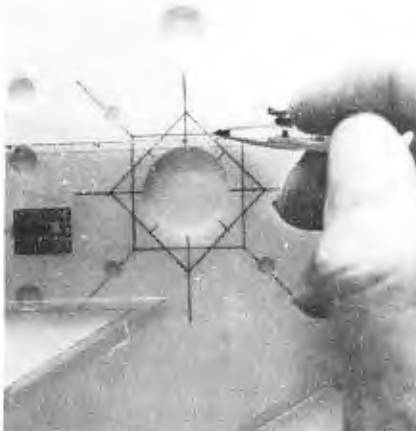


Fig. 3. To make a final line, hold the pen slightly in the direction of the line drawn.

After all letters for a given panel legend have been transferred, carefully erase the guide line.

When labelling your control panel, keep it simple. Shown in Fig. 6 are examples of the right and wrong ways of labelling panels. If one word will do to convey the function of a control, switch, jack, etc., never use two words. Also, group related items together by boxing them in. Use arrows or other graphics to indicate signal or traffic flow—but only if they are necessary to clarify things. A well-designed and properly labelled con-

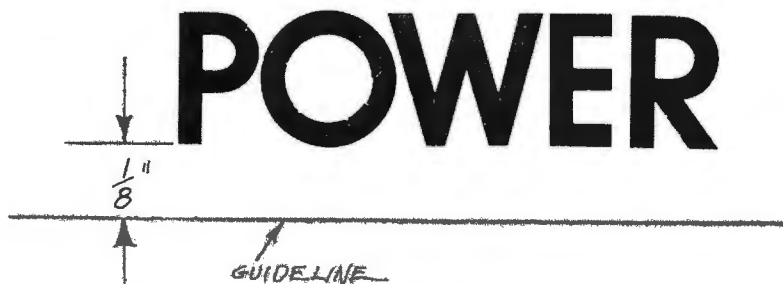


Fig. 4. In using dry-transfer letters, first draw a light line $\frac{1}{8}$ " from bottom of line you want to produce.

should be able to see through the transfer sheet clearly enough to line up your letters parallel with the guide line. As each letter is properly positioned, transfer it by rubbing with a soft, blunt pencil over the area of the letter to be trans-

ferred, as shown in Fig. 5. Practice transferring letters on scrap to determine the optimum rub pressure to use to assure a good transfer. Do not press too hard, or the letters will spread, crack, and flake.

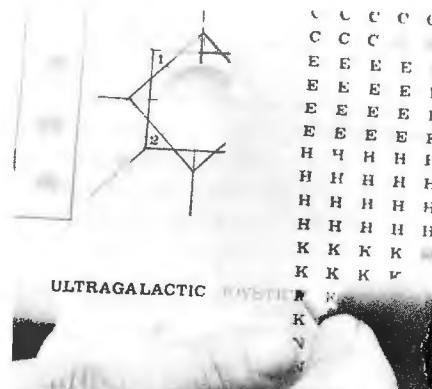
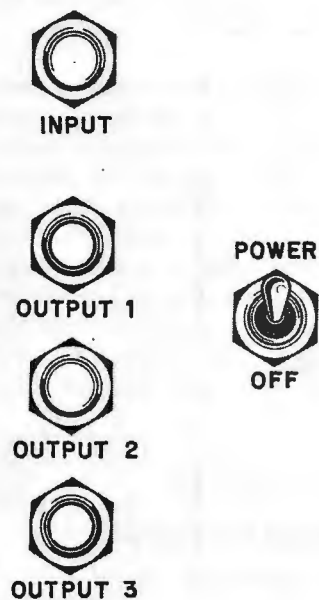
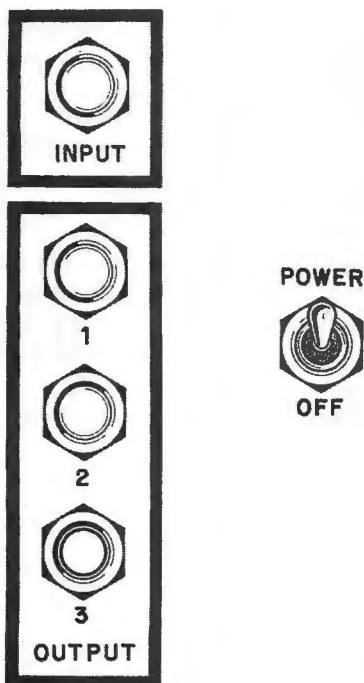


Fig. 5. Transfer each letter by rubbing with a blunt pencil. Too much pressure may ruin the letter.



WRONG



RIGHT

Fig. 6. Examples of the right and wrong ways to label a panel. Group related items, and if one word will describe a group, never label each unit separately.

control panel is not only pretty to look at, it is functional and completely lacking in confusion and ambiguity.

Finishing Up. Transfer lettering and inked lines scratch easily and very quickly deteriorate if they are not protected. While it may at first appear that a couple of coats of clear spray lacquer will provide the required protection, its use can be very tricky. For example, you cannot be assured of perfectly even coating over the entire panel surface. Also, if the first coat of lacquer is too thick, it will in all likelihood lift up or even dissolve the lettering.

The best protection for a control panel's lettering and graphics is clear transparent ConTact plastic film, obtainable from most hardware stores. To use this film, cut it about 1/2" (12.7 mm) longer and wider than the panel to be covered with it. Do NOT remove the entire paper backing from the film. Instead, peel it back gradually as you apply the film to the panel. Bear in mind that you cannot put the film down, change your mind, lift it again, and reapply it. If you do this, you will dislodge the transfer lettering and graphics.

The best technique to use in laying down the clear film is to work very slowly, peeling away only enough of the paper backing to assure that the work progresses at a manageable rate (see



Fig. 7. In using plastic film for protecting a panel, peel the paper from the film slowly. It can't be lifted, once it is down.

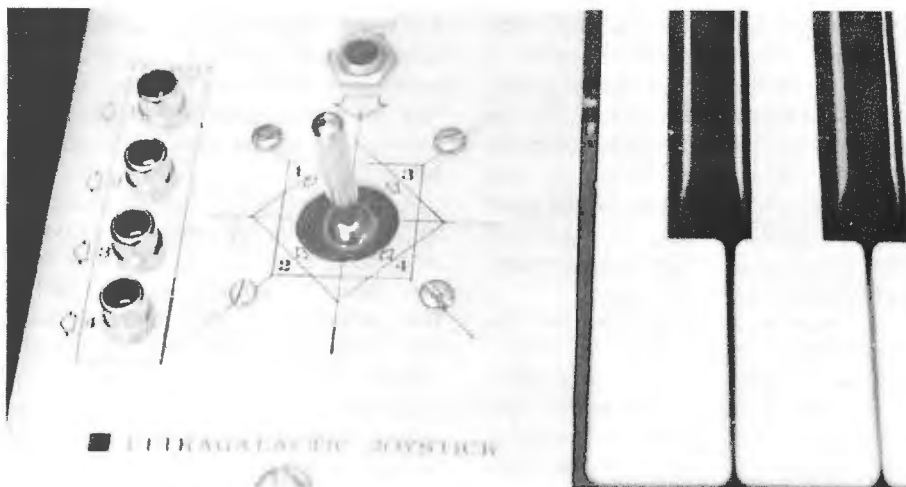


Fig. 8. An example of a completed control panel. The film has been cut away from all holes and the various components have been mounted in proper locations.

Fig. 7). Small air bubbles should be chased to an edge or a hole; larger bubbles should be lanced with a razor blade or X-acto knife. When the film is down, go over every square inch of it with the back of a table spoon, tongue depressor, or other blunt instrument to burnish it down solidly. Then cut the film away from all holes and mount the various components on the panel. An example

of a completely assembled control panel is shown in Fig. 8.

Closing Remark. We have given only the basic techniques to use for designing and fabricating professional-quality control panels. By applying these techniques and gaining some experience in design, you can make projects you will value and be proud to display. ◇

THE Federal Communications Commission is having problems these days with pirates. No, the FCC isn't taking over the duties of the Navy and Coast Guard. These pirates are known as WCPR, WHGC, "Radio King Kong," "Wild Turkey Radio," and even "Radio Clandestine." More and more adventurers, either ignorant or contemptuous of the law, are taking to the airwaves and setting up their own broadcasting stations.

Bootlegging is not a new development. Even in the early days of radio,

band (540 to 1600 kHz) is fair hunting ground for pirate broadcasters. However, recent years have found pirates to be more commonly using frequencies in the upper end and just above the standard broadcast band, say from 1550 to 1650 kHz. This range is becoming popular with pirates because many old AM phone transmitters which cover the 160-meter ham band (1800 to 2000 kHz) can be easily retuned to cover 1550 to 1650 kHz. Much of the available surplus AM gear will cover this range as well.

A second favorite place for pirates is

their limited range, we will not deal with them in this article.

Strictly Hobby Pirates. The major portion of pirate activity in the United States falls into the category of "hobby" activity. These stations are operated solely for the amusement and diversion of the pirates, who have no political cause to advocate. A typical example was WHGC, operating on a varying frequency around 1610 kHz, in Charlottesville, Virginia. This station first popped up in late 1975, and was reported by

Piracy on the Airwaves

*The state of
illegal broadcasting
is explored.*

BY Harry L. Helms

when communication was by Morse code and spark transmitters, an occasional wireless enthusiast would "borrow" another callsign, usually of rare or distant locations, to attract more replies. Amateur radio in the 1930's jokingly had what was called the "bootlegger" class of license, which allowed the holder to use all the power and bands he pleased, plus select his own call—at least until he was caught! Such bootlegging continues today on the amateur bands, with rare DX station callsigns often used by other stations, and operation taking place from countries (such as Turkey) where amateur radio is frowned upon.

The new breed of radio pirates is interested in broadcasting, but not in communicating with other stations. Indeed, there is no shortage of perfectly legal avenues for communication if your desire is to talk with other people by radio. However, if you want to broadcast, you're limited to a mere 100 milliwatts of power in the AM and FM broadcasting bands under Part 15 of the FCC rules. For a growing number of pirates, that simply isn't enough power. Note that neither the author nor POPULAR ELECTRONICS advocates that anyone set up a pirate station. The FCC rules provide for a maximum penalty of \$10,000 fine and/or a year imprisonment for those caught broadcasting illegally.

Where Pirates are Found. Almost any frequency in the standard broadcast

the 49-Meter international shortwave broadcasting band (5900 to 6200 kHz). The upper end of 49 meters, around 6200 kHz and just above, has long been favored by pirate broadcasters in Europe. A big advantage of this band is that much wider range can generally be obtained than on the broadcast band, particularly since fully resonant antennas are generally more feasible on 49 Meters than on the standard broadcast band.

A final good place to look for pirates is in the 41-Meter amateur/international-broadcast band (7000 to 7300 kHz and just above). This range is populated by both broadcasters and amateur operators. A big advantage of this band for pirates is that plenty of AM equipment is available for the band ready to use without any further modification. A big disadvantage is that interference is often tremendous, and the relatively flea-powered pirates often can't cut the mustard.

Those readers in urban areas might also want to keep an ear on the 88-to-92-MHz segment of the FM broadcast band. This portion of the band is normally reserved for educational stations, some of which use powers as low as 10 watts. Quite often, a "pirate" station of sorts will pop up here, generally for a day or two. These are almost always the result of students at a school using a legitimate licensed transmitter in an unauthorized manner. Due to the highly sporadic nature of such operations, and

members of the National Radio Club as far away as Delaware. Programming consisted of gospel music and religion (quite a contrast from the rock music and obscenities that many pirates put out). When the station was contacted by members of the National Radio Club, the operator claimed that it was operated on a limited-radiation carrier-current basis that was legal under FCC rules Part 15, and that he couldn't imagine how the station was being heard so far. One resourceful NRC member even managed to extract a verification from the station that specified power as 100 milliwatts.

On March 4, 1976, however, FCC agents from the Commission's Norfolk office raided and shut down WHGC. Far from being a mere 100 milliwatts, the station was actually operating at 50 watts. The gospel music programming was explained by the fact that the station was built and run by the son of a minister, with the station itself being located in the back of a church in Charlottesville! Luckily for the young operator, the FCC merely issued a warning, suspending further action on the condition that no more illegal operation take place.

A bizarre operation was the "WDRC-FM" relay that operated on 1630 kHz. This station did nothing more than relay the programs of station WDRC-FM in Hartford, Connecticut. In late December, 1974, various BCB DX'ers noted a station on 1630 kHz that identified as

WDRC-FM. In fact, the station itself got a report from a frequency monitoring and checking service in Cleveland, Ohio about the strange signal. An NRC member and WDRC's chief engineer used direction-finding techniques to determine that the illegal transmitter was in Meriden, Connecticut. In mid-January, 1975, Federal Communications Commission agents, alerted by DX'ers and the WDRC staff, shut down the illegal transmitter. The station operator turned out to be a former employee of WDRC. WDRC-AM, by the way, transmits on 1360 kHz—and the pirate used 1630 kHz!

The granddaddy of all hobby pirates, however, has to be the WCPR operation. WCPR used a varying frequency of around 1620 kHz from its location in Brooklyn, New York. The station was first noted in late December 1975 and was quickly reported over a wide area from the Southeastern states to the Midwest. Station programming consisted of rock music and listener phone-ins week-end nights from approximately 0430 to

0700 GMT. The station announcer called himself, somewhat unoriginally, "John Doe."

Callers to WCPR's announced numbers were given an address to which to send reports. Unfortunately, reporters only received "thank you for tuning in" letters instead of detailed verifications. Meanwhile, some DX'ers noted that the numbers that WCPR announced were some of those that the telephone company uses for internal purposes, and speculation arose that someone inside the telephone company was aiding in the operation, because when the WCPR numbers were called when the station was not operating, nothing happened—no busy signal, no dial tone.

WCPR continued along, featuring calls from DX'ers and casual listeners from all over the eastern half of the United States, until it was raided and closed by the FCC on February 7, 1976. Transmitter power was only 100 watts, and FCC agents expressed amazement that it had been heard in the Midwest. As is usually the case, the operators of the

station turned out to be rather young, in their late teens and early twenties. Although the FCC apparently decided not to prosecute the persons involved for operating a transmitter illegally, problems still remain. Prosecution may still result from the tampering with telephone company circuits.

A glance at our "sampler" of pirate activity will show similar operations scattered throughout the three main pirate bands. Of particular note, however, is the "Radio King Kong" operation reported around 6025 kHz in February and March of 1974. Many pirate broadcasters over the years have called themselves "Radio King Kong," as one of the "pioneer" pirate broadcasters used that name. However, it is not believed that any of the various "King Kong" operations are related. Don't be too surprised if another "Radio King Kong" pops up sometime in the future!

Political Pirates. Political pirate broadcasters are much more common in Europe than here. Much of the political pirate broadcasting activity is government run. Relatively little such activity has occurred in the United States.

In the early Spring of 1975, an illegal station showed up on 1580 kHz near Keshena, Wisconsin. Operated by sympathizers of the Menomonee Indians, the station billed itself as the Menomonee Warriors' Station and announced its frequency as 1600 kHz, despite its actual frequency. It was strong enough to interfere with reception of WAPL, Appleton, Wisconsin on 1570 kHz.

The most recent political pirate was WCPU on 1629 kHz, which appeared in mid-February 1976 shortly after the FCC closure of WCPR. The announcer urged listeners to write the FCC and Congress urging them to open up frequencies above 1610 for hobby broadcasters. WCPU claimed to be the most powerful pirate broadcaster ever, and its signals gave credibility to that claim. Location was believed to be somewhere in the Midwest.

"DX" Pirates. Many DX'ers and SWL's get a big kick out of hearing a pirate. Do they ever get the urge to put a pirate station on the air themselves?

Many members of various radio clubs who are known to have somewhat sympathetic "live and let live" views toward pirate broadcasting have at times received advance notification that a pirate was about to take to the air. But since many DX clubs publish membership lists, complete with addresses, such

SAMPLER OF RECENT PIRATE BROADCASTING ACTIVITY

Frequency (kHz)	Comments
850	WHBL, Bayonne, New Jersey (announced location), rock music and identifications as "The Music Machine, WHBL, Radio 86, Bayonne." Active mid-January 1975, poor technical quality.
1580	Menomonee Warriors' Station, near Keshena, Wisconsin, active during unrest in area, early Spring 1975.
1610v*	WHGC, Charlottesville, Virginia, gospel music and religion, pretended to be carrier current, 50 watts of power, run by son of a minister, active late Autumn 1975 until closed by FCC March 4, 1976.
1620v	WCPR, Brooklyn, New York, used rock music and telephone call-ins, widely heard from December 1975 until closed by FCC in early February 1976. Transmitter was 100 watts.
1629	WCPU, location unknown but believed to be in the Midwest, announced 1615, urged listeners to write FCC and Congress to open up frequencies for hobby broadcasters, excellent signals, active mid-February 1976 following WCPR closing.
1630	"WDRC-FM Relay," Meriden, Connecticut, relayed WDRC-FM programming from late December 1974 until closed by FCC in mid-January 1975.
5035v	"Wild Turkey Radio," location unknown, English talks, much profanity, DX items from radio club bulletins. Even verified reports of its reception in club bulletins! Active December 6 through 10, 1973.
6025v	"Radio King Kong," announced as being 20 miles off coast but believed to be in middle Atlantic states, rock music and obscenities, February and March, 1974.
6030	"Radio Clandestine," announced as being on a ship but believed to be in New York-Pennsylvania area, rock and political commentary, requested reports to NYC address, active mid-December 1973.
6158v	Unidentified station, believe USA location, programs against telephone and other excise taxes (a favorite target of anti-Vietnam War groups), active early autumn 1972.
7229	Unidentified, believed to be in Philadelphia area, rock music and dedications, active early September 1973.
7415	WTIT, location unknown, "The Sound of Young America," rock music, announced 50 watts, mid-February 1973.

*v=frequency varies somewhat

advance notification did not prove that any DX'ers or SWL's were guilty of pirate activity.

Many pirates show a surprising knowledge of DX'ing. One example is the case of "Radio Clandestine," which showed up in mid-December 1973 on 6030 kHz. Reception was good throughout the Northeast, with programming consisting of rock music and political jokes. The host gave his name as "R.F. Burns," claimed to be operating from a ship off the Atlantic coast, and requested reports to a New York City address in care of the "SINPO code foreman." Quite obviously, the operators of this station were aware of clandestine activity (a favorite subject with many DX'ers) and were well aware of that favorite SWL reporting code, the SINPO system.

The "clincher" to link some SWL's and DX'ers to pirate activity came in December of 1973. From December 6 through 10, a station was heard around 5035 kHz announcing as "Wild Turkey Radio, the Voice of the Pilgrim Underground." Programming consisted of English language talks spiced with much profanity. One feature was a "DX corner" that featured items straight out of "FRIENDX," the monthly DX bulletin of the North American Shortwave Association. A DX'er in Ottawa, Canada heard the station and reported reception of it to the January, 1974 issue of "FRIENDX." He did not send a report to the station because no address was given.

A surprise arrived a few months later for the Canadian DX'er. It was a verification letter for "Wild Turkey Radio," signed by "Pullet" and "Gobbler," and airmailed from Turkey! Despite the postmark, Canadian government monitors believed the station to be located somewhere in the Winnipeg, Manitoba area. Quite clearly, though, the operators of "Wild Turkey Radio" had connections with the SWL community and access to "FRIENDX." More probable, in the opinion of many people, was the notion that "Pullet" and "Gobbler" were members of NASWA!

Hearing Them Yourself. Most broadcast-band pirate activity takes place on weekends, usually after midnight, and many DX'ers scan 1600 to 1650 kHz every weekend night in the early hours. Activity on the 49- and 41-Meter bands tends to be concentrated in the afternoon hours, as heavy interference from legal broadcasters often makes evening and night reception on these frequencies difficult for low-power stations. ◇

Making Digital Electronic Clocks Immune to AC Flicker

BY ANDREW FRASER

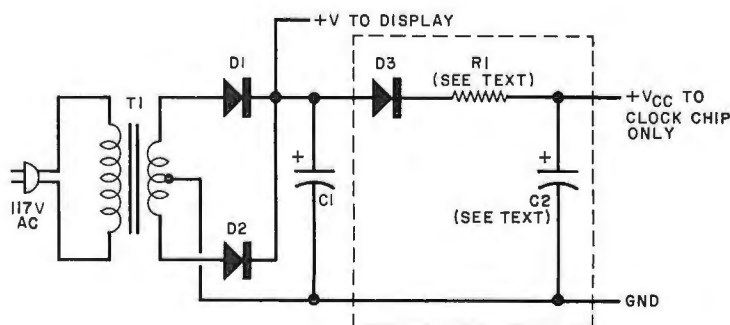
AN OCCASIONAL "flicker" on the ac line can interrupt power to a digital clock for up to a second. This can cause the filter capacitor in the clock's power supply to discharge through the displays to the point where the clock must be reset for accurate time. If you have encountered this problem, the circuit we present here can correct it.

A typical power supply for a digital clock consists of transformer *T1*, diodes *D1* and *D2*, and filter capacitor *C1*. The flicker-eliminator modification in this circuit consists of the components inside the dashed-line box. Now, power for the clock chip is obtained via *D3*, *R1*, and *C2*. When the ac line flickers, the current drawn by the displays will begin to discharge *C1* but the charge on *C2* will not go to the displays because under this condition *D3* will be in reverse bias.

MM5316 clock chip that draws 5 mA and can operate down to 8 volts, *C2* can keep the clock chip (but not the displays) operating for several minutes. Most line flickers do not last this long. Also, this means that you can unplug your clock and move it to another location without having to reset it.

Resistor *R1* in the add-on circuit limits the current flow to *C2* during the charge cycle. If the power supply delivers 12 volts, a value of 100 ohms at 12 watts for *R1* will limit charging current to 120 mA. This allows *C2* to become fully charged in several seconds. If you use a lower-value capacitor for *C2*, *R1*'s value and power-handling capabilities can be reduced proportionately, or *R1* can be eliminated altogether.

This flicker-eliminator technique can also be used with low-power RAM's in



This circuit provides power to a clock chip to prevent flicker.

Hence, while the charge on *C1* might be quickly drawn off by the displays, the power delivered to the clock chip from the charge on capacitor *C2* will remain relatively constant.

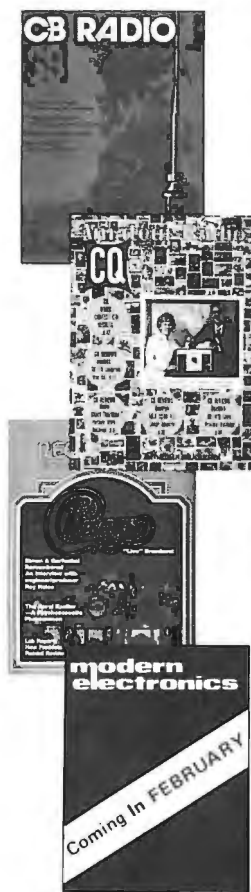
If a power supply normally delivers 12 volts and capacitor *C2* is a very high value (say 10,000 μ F) and you are using an

computer memory systems to prevent loss of stored data when a transient flicker occurs. The amount of "safety" time again depends on the value of *C2* and the current demands of the memory system. Therefore, the higher the value of *C2* and the lower the current demand, the longer the safety time. ◇

4 great magazines

SPECIAL BARGAIN RATES

All four of these magazines sell for \$1.50 on newsstand, and \$9 to \$12 a year on subscriptions. If you order one or more subscriptions from the coupon below, you'll enjoy big savings over regular sub rates. Buy 2 subs and take an extra 5% discount. Buy 3 subs and take an extra 10%. Order all 4 and save an extra 20%.



For The CBER

S9's the oldest, biggest and most widely read CB magazine in the world. Edited by Tom "Tomcat" Kneitel, it's got all the best writers in the CB field, plus great extras for the swl, vhf buff, or would-be ham. S9 not only tells you what's happening now, but what's going to happen in the future and why. Must reading for every CBER from 18 to 80.

For The Radio Amateur

CQ's the oldest and best read independent ham radio magazine anywhere. Mostly aimed at the operating end of ham radio, with a goodly amount of tech projects, radio theory and, of course, all the new products for the amateur. If you're already a ham, or about to become one, you'll love CQ.

For The Music Recording Buff

Modern Recording's only two years old, and already hailed as the "only" mag to read for anyone interested in creative sound. Features stories on all the top recording stars, and what goes into the sound they make. Heavily electronic oriented. Covers, mixers, amplifiers, instruments, and naturally, people.

For the Electronic Hobbyist

A brand new monthly magazine that covers all phases of hobby electronics with a different twist. Modern Electronics tells you what's new in computers, audio, electronic gadgets, personal communications, and TV games. But it goes much further. This mag covers what's new and why. How-to-do-it projects galore. Many new devices never before covered in any electronic magazine. The hobby magazine of electronics tomorrow--for reading today. You can't be without it.

Magazine	Newsstand price (1 yr)	Regular Sub	Special Sub
S9	\$18.00	\$12.00	\$9.95
CQ	18.00	9.00	7.95
Modern Recording	18.00	12.00	9.95
Modern Electronics	18.00	12.00	8.95

COWAN PUBLISHING CORP.
14 VANDERVENTER AVENUE
PORT WASHINGTON, NY 11050

ALLOW EIGHT WEEKS FOR
DELIVERY OF FIRST ISSUE

GENTLEMEN:

PLEASE ENTER MY SUBSCRIPTION(S) FOR THE FOLLOWING MAGAZINE(S) FOR THE NEXT 12 ISSUES:

☐ CB RADIO/S9 ☐ MODERN RECORDING
☐ CQ ☐ MODERN ELECTRONICS
I enclose ☐ CHECK ☐ MONEY ORDER
or Bill my ☐ MASTER CHARGE ☐ BANK AMERICARD

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
 Interbank No. Exp. Date Mo. Year

NAME _____
 ADDRESS _____
 CITY _____ STATE _____ ZIP _____

BUILD A FIELD DISTURBANCE SENSOR FOR SECURITY

*Inexpensive alarm device
detects light changes
in its field
of view.*

BY KEN POWELL

The Field Disturbance Sensor presented here is a useful security device wherever a reasonable amount of ambient light exists, such as in an office supplies area or a store showroom. Since it does not radiate an r-f or ultrasonic signal, it cannot be easily detected. Featuring a quasi-memory, it can detect removal of an object as well as the addition of one within its field of view.

Thus, the Field Disturbance Sensor is difficult to defeat, versatile and easy to build owing to a low parts count, and readily available components can be used. Initial adjustments require only a multimeter.

Theory of Operation. The Field Disturbance Sensor functions like a simple camera, with two light-dependent resistors (LDR's) or photocells taking the place of film. A lens projects the image or field of view onto the sensitive surfaces of the photocells. The resistance of each cell is determined by the amount of light reaching it. When the field of view is normal (that is, when desired conditions in the field exist), the cell resistances will assume specific values. If an object passes through, is added to, or removed from the field, the intensity of light impinging on the cells, and thus their resistance values, deviates from the chosen norm. Any change in the ambient light level also changes the photocells' resistances.

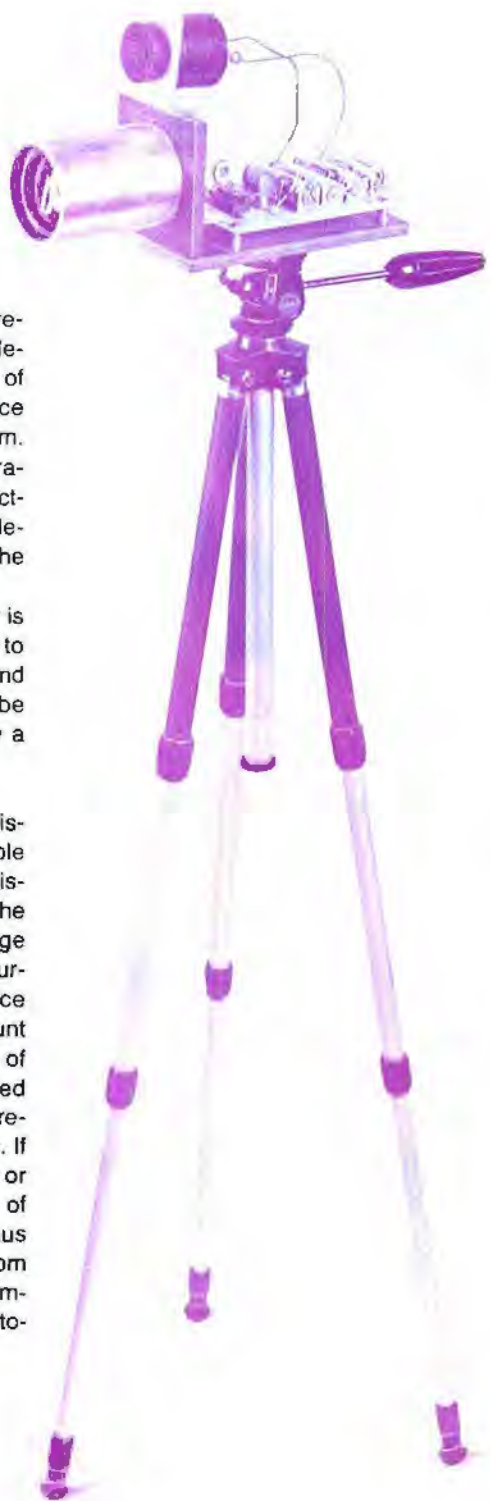
Two IC comparators monitor the LDRs' resistances and activate an audible alarm if they vary by more than a

predetermined amount. The alarm will continue to sound as long as the field is disturbed. Thus, if a person is moving through the field, the comparators activate the alarm as long as he is in view. If an object is added or removed from the field, the alarm continues to sound until the object is withdrawn or replaced, respectively.

About the Circuit. The schematic diagram of the Sensor is shown in Fig. 1. Cadmium-sulfide photocells *LDR1* and *LDR2* are connected in series to form a voltage divider and placed behind a lens (see Fig. 2). As the field of view is altered, the resistances of the photocells vary inversely in proportion to the amount of light striking their sensitive surfaces. An object entering the right side of the field of view produces a greater effect on the left photocell, and vice versa. A change in resistance of either cell causes a variation in the voltage at the junction of the two cells. This voltage is called V_{IN} .

A second voltage divider comprising *R2*, *R3*, and *R4* provides reference voltages for comparators *IC1* and *IC2*. These references are designated V_{UT} and V_{LT} . The upper threshold (V_{UT}) is applied to the noninverting input of *IC1* and the lower threshold (V_{LT}) is applied to the inverting input of *IC2*. Voltage from the junction of the photocells (V_{IN}) is applied to the inverting input of *IC1* and the noninverting input of *IC2*.

Potentiometer *R1* is placed in parallel with *LDR1* so that V_{IN} can be trimmed to one



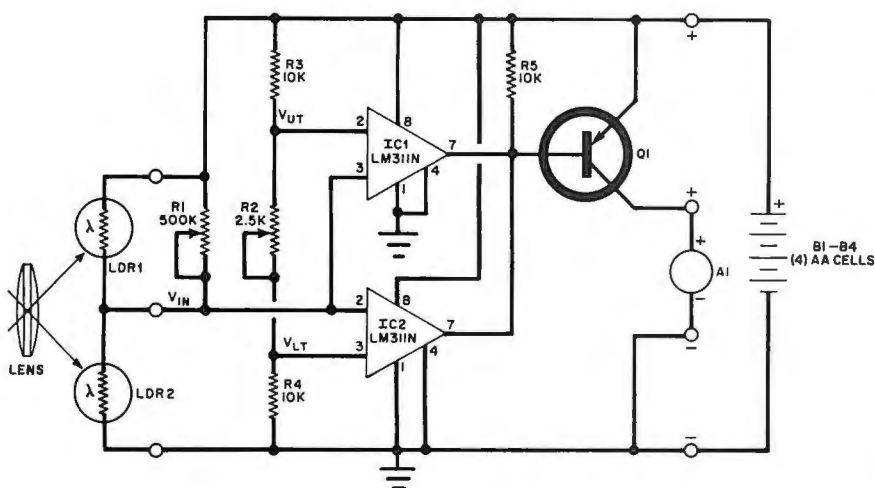


Fig. 1. Light hitting LDR's determines inputs to op amp comparators.

PARTS LIST

A1—Mallory SC628P Sonalert, or similar
 B1 through B4—AA cells
 IC1, IC2—LM311N comparator
 LDR1, LDR2—Cadmium-sulfide photocell (Radio Shack 276-116)
 Q1—Pnp silicon switching transistor (Radio Shack 276-2024)
 R1—500,000-ohm trimmer potentiometer (Radio Shack 271-221)
 R2—2500-ohm trimmer potentiometer (Radio Shack 271-228)
 R3, R4, R5—10,000-ohm, 1/4-watt, 5% tolerance resistor

Misc.—Bi-convex 50.8 × 50.8 mm lens (available for \$19.50, No. 01 LDX 115, from Melles Griot, 1770 Kettering Street, Irvine, CA 92714); rubber "O" rings; cement; suitable wood, plastic or metal stock and tubing; IC socket or Molex Soldercons; battery holders (Radio Shack 270-1433); printed circuit board (available from J. Oswald, 1436 Gerhardt Ave., San Jose, CA 95125, for \$3.50); hookup wire, etc.

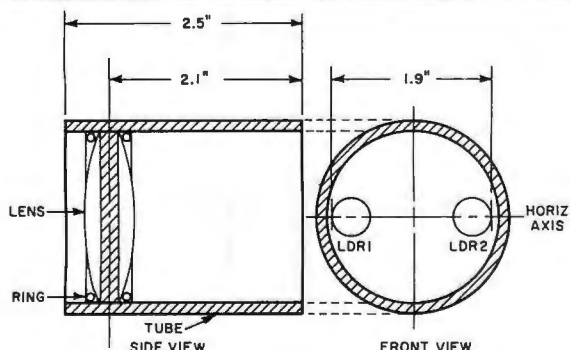


Fig. 2. Dimensions for cutting PVC pipe to make lens assembly

half the supply voltage (3 V). Potentiometer R2 adjusts the reference voltage divider so that V_{UT} will be slightly greater than V_{LN} and V_{LT} will be slightly less than V_{LN} . When this occurs, the outputs of both comparators (uncommitted collectors on-chip) are high and Q1 is cut off. No current flows through alarm A1.

Any change within the field of view will cause variations in the resistances of LDR1 and LDR2 and in the magnitude of V_{LN} . If the change decreases the resistance of LDR1 or increases the resistance of LDR2, V_{LN} will exceed its initial value. When V_{LN} is greater than V_{UT} , IC1 will change state and its output will go low. This will forward bias Q1 and

energize the alarm. If the photocells are affected in the opposite manner, V_{LN} will drop below its initial value. When V_{LN} is less than V_{LT} , the output of IC2 will go low, forward biasing Q1, which in turn sources current for the alarm.

In effect, we have set up a voltage window by adjusting R2. This window is centered around V_{LN} . Any variation in V_{LN} which exceeds this voltage window activates the alarm. The window can be made very narrow—on the order of a few millivolts at the maximum sensitivity of the Sensor.

Construction. The project comprises a lens assembly, a printed circuit board, and a base. The lens is 2" in diameter and has a focal length of 2" (50.8 × 50.8 mm). A lens tube can be fabricated from a cardboard mailing tube, aluminum or PVC pipe. Two-inch I.D. PVC pipe is easily cut to size and cements readily to other plastics and wood. Dimensions for the lens tube are shown in Fig. 2. The lens is mounted in the tube with a pair of rubber "O" rings (available from hardware stores). When the rings and lens are properly positioned in the tube, the rings should be secured in place with a few drops of cement.

The base assembly can be constructed from plastic, wood or metal. Suggested dimensions are shown in Fig. 3. The prototype has a hole centered on the bottom side of the base tapped for 1/4" × 20 threads. This facilitates mounting the project on a camera tripod. A small "L" bracket to hold the alarm can be formed from a 2" × 3" (5.1 × 7.6 cm) piece of steel or aluminum stock.

Photocells LDR1 and LDR2 are mounted on the base assembly after a preliminary test. Place the cells side by side on a flat surface about 6" (15.2 cm) from a light-colored wall which is il-

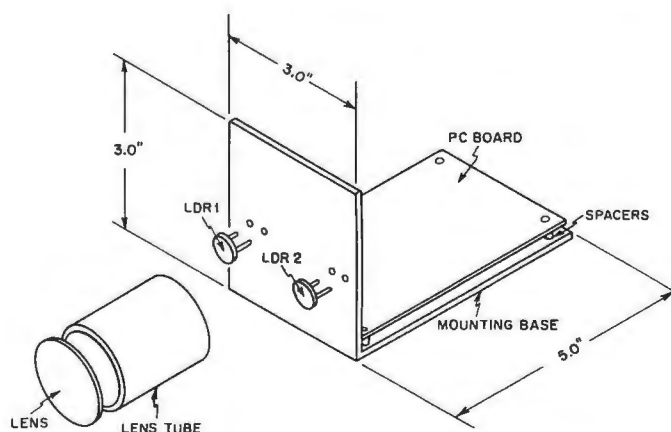


Fig. 3. Instructions and dimensions for assembling the base. A hole in the bottom can be used for tripod mounting.

luminated with normal ambient light. Measure the resistance of each cell and denote the one with the higher resistance *LDR1*. Then mount the LDR's on the base assembly, securing them with cement. The photocells should be spaced as far apart as possible, but be sure they can be encompassed by the lens tube. Then cement the lens tube to the base assembly.

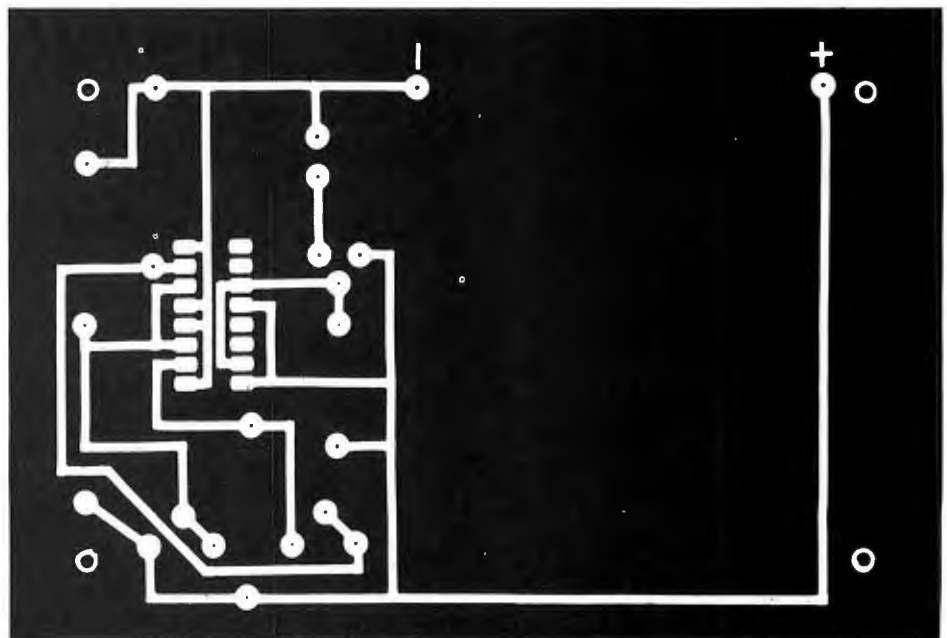
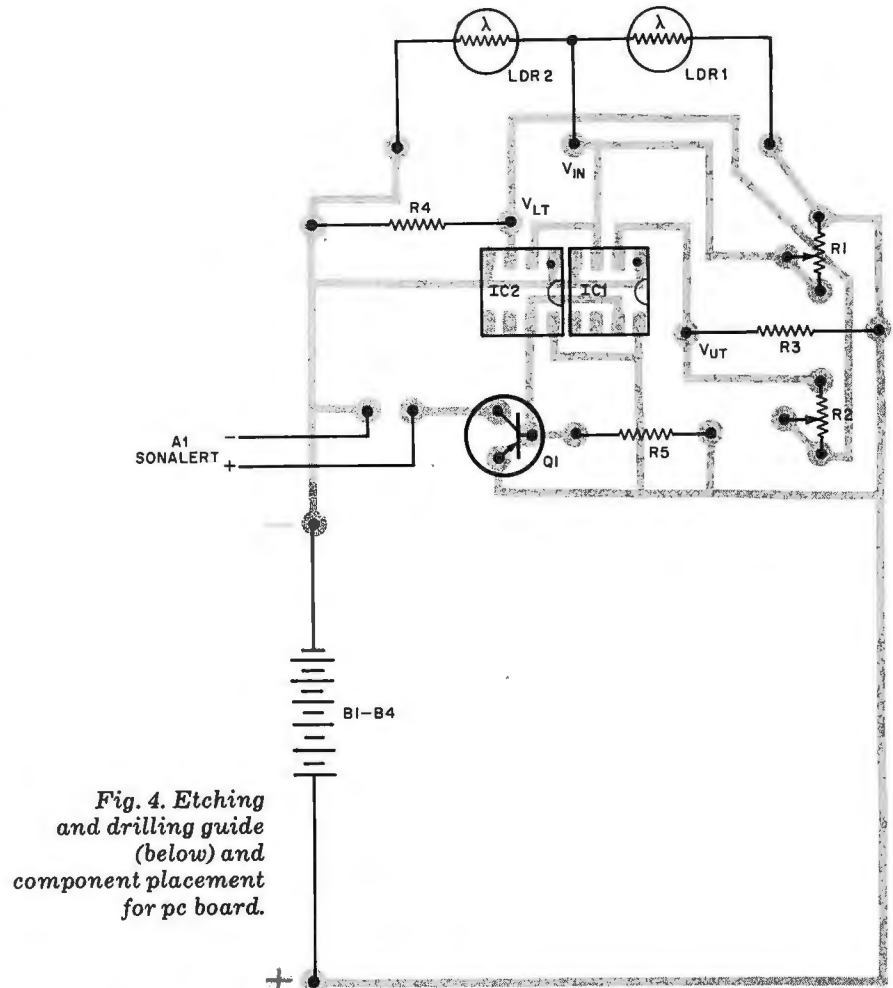
Suitable etching and drilling and parts placement guides for the printed circuit board are shown in Fig. 4. Both IC's can be mounted in a single 16-pin socket, or Molex Soldercons can be used. Connect lengths of hookup wire to the pc pads for the LDR's and the Sonalert. Be sure to leave enough wire for the leads to reach their respective components when the printed circuit board is installed. Battery holders for the four AA cells can be mounted directly on the board. When all components and leads are in place, the pc board is mounted on the base assembly with $\frac{1}{2}$ " (1.27-cm) spacers and No. 4 hardware. Double check your wiring and orientation of semiconductors. Then install the batteries in their holder. The project should start beeping loudly.

Adjustment. Place the Sensor in position to cover the desired field of view. (Remember that adequate ambient light is required for correct operation of the project.) Apply the positive probe of a voltmeter to point V_{IN} and the negative lead to ground (battery negative). Adjust *R1* for a reading of approximately 3 volts. Then move the negative probe to point V_{IN} and the positive probe to V_{UT} . Adjust *R2* for the smallest voltage possible without activating the alarm. When these adjustments are performed, V_{UT} will be slightly positive with respect to V_{IN} , and V_{LT} slightly negative.

The sensor is now operational. Have some fun trying to outwit it!

Use. Keep in mind that the project operates on ambient light. Accordingly, adequate lighting must be maintained where the Sensor is to be used. Under good lighting conditions, as found in most offices and showrooms, the Sensor functions over a distance of 25 feet (8 m) or more if the intrusion or change provides a moderate contrast to the existing background. Closer in, the project will detect such changes as smoke or fire.

To alter the pattern of the field or to gain greater light-gathering power, different lenses could be used. Also, more sensitive photocells could be employed. The audible alarm could be supplemented or replaced by a relay for intercon-




nection with an existing alarm system. There are obviously many possibilities for those inclined to experiment!

Battery life will depend on the number and duration of alarms. Quiescent current drain is only four milliamperes, so long life can be expected from the AA cells, especially if alkaline batteries are

used. Of course, you could also use NiCd cells or a line-powered, regulated low-ripple dc supply with back-up batteries. No matter how you power the Sensor, you will find it fun to build, even more fun to attempt to defeat, and in proper applications, a very good and useful security device. ◇

*Allows color enlargers to give
consistent quality in spite
of line-voltage fluctuations.*

BY D. W. SCHNEIDER



ADD VOLTAGE REGULATION TO A COLOR PHOTO ENLARGER

HAVE YOU ever matched your color enlarger's filter pack to a negative, only to discover that the resulting color print's color quality was imperfect? This is often due to fluctuations in line voltage, which occur when high-power appliances turn on or off.

This problem can be solved by using an inexpensive voltage regulator, such as the one presented here.

The project to be described will maintain dc voltage for the enlarger's lamp at line level within $\pm 1\%$, even if the ac line voltage varies $\pm 10\%$. The regulator circuit uses readily available parts and can be built for approximately \$20.

About the Circuit. The voltage regulator is shown schematically in Fig. 1. Isolation transformer *T1* applies 117 volts rms ac to modular bridge rectifier *RECT1*. Pulsating dc from the bridge is filtered by electrolytic capacitors *C1* and *C2* into a fairly smooth 160-volt dc level. Zener diodes *D1* and *D2* together with resistor *R2*, form a voltage regulator. The series zener combination produces a regulated output of 118 volts dc. Resistor *R2* limits zener current to a safe value and provides base current for *Q1*.

The voltage at the base of *Q1* is governed by the zener action of *D1* and *D2*, and is thus substantially independent of variations in line voltage. Even if the line voltage drops 10 volts, the filtered output of the rectifier is greater than the combined zener voltages. This is so because the filter output is approximately equal to the peak value of the ac line's waveform, not its rms value. Unless the line voltage decreases greatly, there will always be enough current in the zener diodes to keep them operating in the avalanche region. The zener voltages will therefore remain constant within $\pm 1\%$ or so.

Most enlargers use incandescent

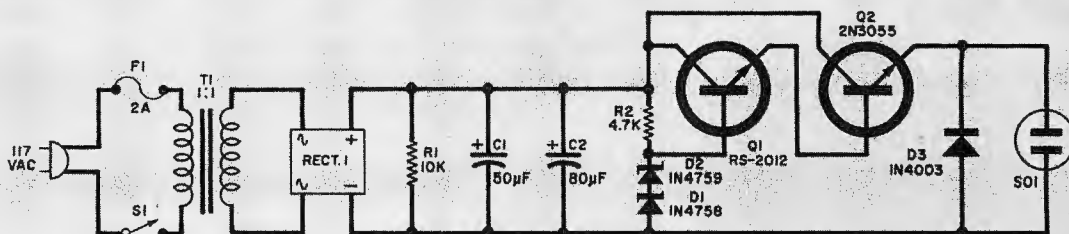


Fig. 1. Circuit has zener diode regulation and amplifier pair.

PARTS LIST

- C1, C2—Dual (80- and 50- μ F, 250-volt) electrolytic capacitors or equivalent.
 D1—1N4758 56-volt, 1-watt zener diode
 D2—1N4759 62-volt, 1-watt zener diode
 D3—1N4003 silicon diode
 F1—2-ampere fuse
 Q1—RS-2012 (Radio Shack) npn silicon transistor
 Q2—2N3055 npn silicon power transistor (Radio Shack 276-1634. See text.)
 R1—10,000-ohm, 10-watt wirewound resistor
 R2—4700-ohm, $\frac{1}{2}$ -watt carbon composition resistor
 RECT1—400-PIV modular silicon bridge rectifier (Radio Shack 276-1173 or equivalent)
 S1—SPST switch
 SO1—Ac power socket
 T1—25.2-volt, center-tapped, 2-ampere transformer (Radio Shack 273-1512) or 117-volt isolation transformer (Stancor No. 6410). See text.
 Misc.—Suitable enclosure, TO-3 heat sink, mica washers, and transistor socket, zinc oxide silicone heat sink compound, line cord, strain relief, terminal strips, fuse holder, magnet wire, solder, insulated sleeving, machine hardware, fiber shoulder washers, flat black paint, etc.

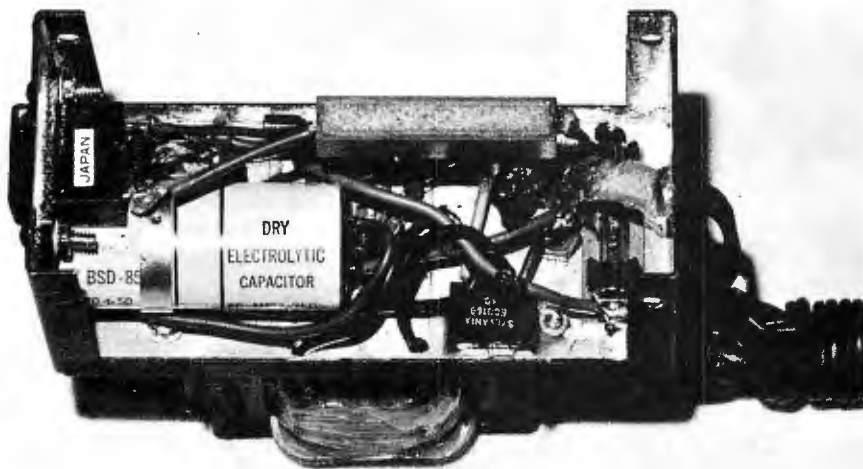


Fig. 2. Photo shows how prototype was made with point-to-point wiring.

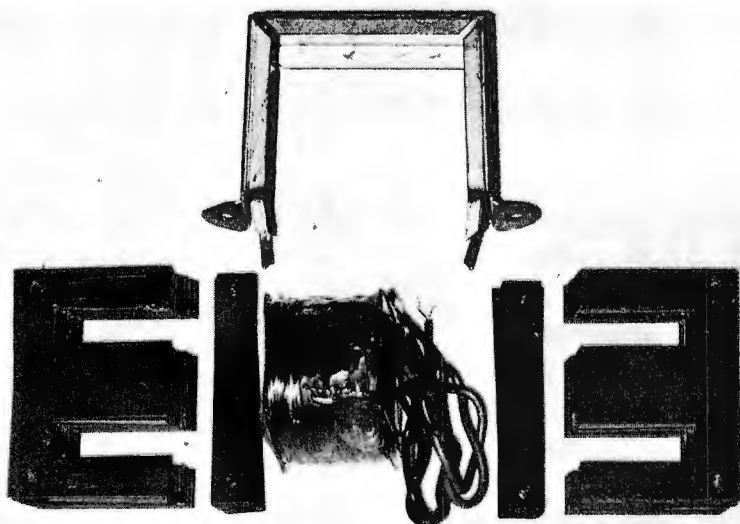


Fig. 3. Transformer T1 can be made by modifying a readily available model. This shows the parts of the transformer disassembled and ready for re-winding.



Fig. 4. Photo of assembled prototype shows transformer mounted on heat sink.

lamps drawing 75 or more watts. If zener diodes alone were used as voltage regulators, they would have to have very large power dissipation ratings. The cost of such diodes is prohibitive. However, the Darlington amplifier composed of Q1 and Q2 allows the use of small (1-watt) zener diodes. The diodes present a regulated voltage which drives the Darlington pair. Two diode voltage drops (approximately 1.2 volts) cause the output voltage at the emitter of Q2 to be slightly less than the combined zener voltages.

The voltage regulator as shown has been successfully used with enlargers containing 75-watt incandescent bulbs. If your enlarger has a lamp that requires more than 100 watts, output transistor Q2 should be a premium 2N3055 rather than the hobby-grade component specified in the Parts List.

Construction. The regulator can be
POPULAR ELECTRONICS

assembled using point-to-point wiring and terminal strips. The project should be housed in a 5" x 2 1/4" x 2 1/4" (12.7 x 6.4 x 6.4 cm) aluminum utility box. When you have procured all necessary parts, lay them out in the box as in Fig. 2. Drill mounting holes for those parts which are directly attached to the box (fuseholder, terminal strips, power switch, retaining band for the electrolytic capacitor, etc.) Holes must also be drilled for Q2's heat-sink and isolation transformer T1. Make a cutout in the box to allow clearance for the socket used with Q2.

Mount all components in the utility box except for T1 and the transistor/heat sink assembly. Wire the components according to the schematic diagram. (Use insulated sleeving liberally.) Be sure to observe polarities of C1, C2, D1 through D3, and Q1. Next, mount Q2 on the heat sink in the following manner. Spread a layer of zinc-oxide silicon heat sink compound on the bottom of Q2's case, on each side of the two TO-3 mica washers, and on top of the heat sink where Q2 will sit. Pass the two washers over the pins of Q2, and position the transistor on the heat sink.

Holding the transistor in place, turn the heat sink over and lay two fiber shoulder washers on the holes drilled in

the heat sink for the transistor's retaining screws. Then mount a TO-3 socket by pushing it down over the protruding transistor pin leads. Secure the assembly with 6-32 machine screws. (It might be necessary to enlarge the threads in the transistor socket with a 6-32 tap to accommodate the machine screws.) Be sure that the shoulder washers isolate the machine screws from the heat sink.

Mount the transistor/heat sink assembly on the utility box with machine hardware. Wire the transistor socket according to the schematic. To maximize the project's ability to dissipate heat, all exterior surfaces of the utility box and heat sink should be coated with a layer of flat black enamel spray paint.

Transformer T1 can be made by modifying a Radio Shack 25.5-volt, center-tapped power transformer. Separate the transformer mounting bracket from the laminated iron core by bending the two metal tabs on the bottom of the bracket outward. This will allow the core to slip out. The "E" and "I" shaped laminations can then be removed one at a time from the plastic bobbin on which the transformer windings are wound. Tapping the laminations with a small hammer will loosen the varnish between them, allowing the end laminations to be slid out. A

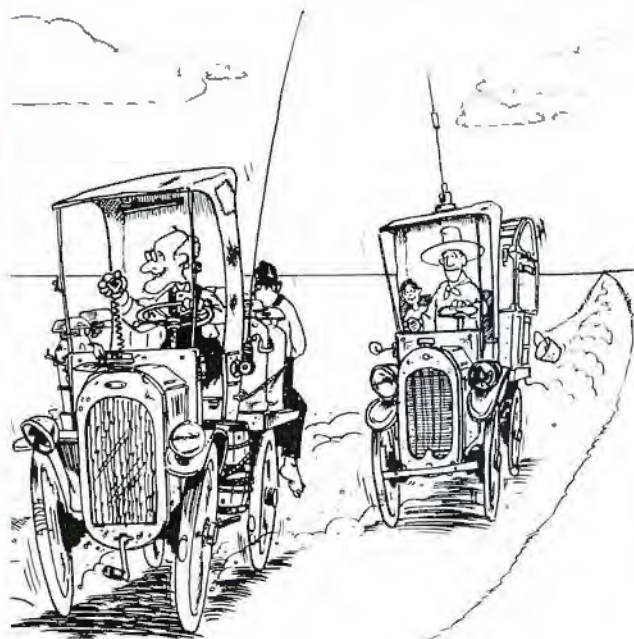
photo of the disassembled transformer is shown in Fig. 3.

When the wound plastic bobbin is free, remove the outer, larger diameter (approximately No. 20) copper secondary winding. Do not disturb the inner primary winding or its insulated leads. Wind approximately 670 turns of No. 26 or 28 enameled magnet wire in place of the secondary just removed. Scrape some enamel from the new secondary wires and solder insulated leads to them. If desired, seal the windings with coil dope. Wrap a few turns of vinyl electrical tape (Scotch No. 33 or equivalent) over the windings. Then paint the transformer bracket with flat black enamel and reassemble the transformer.

In the prototype, the transformer was mounted on the heat sink over Q2, as shown in Fig. 4. If preferred, a more expensive and slightly larger isolation transformer such as the Stancor No. 6410 can be used in place of the modified 25.2-volt transformer.

Use. Plug the line cord from the regulator into the power socket on the exposure timer. Then plug the power cord from the enlarger into power socket SO1. The voltage regulator is now ready for use in the production of prints. ◇

PE COMICS CORNER By Frank Bolle



"Hey, four wheeler.
Looks like we got us a convoy!"



New Sinclair Cambridge Programmable.

An astonishing \$29.95!

How pocket calculators grew up

A couple of years ago, calculators took a step forward. Programmability transformed the slick slide-rule calculator into an advanced scientific machine.

Sadly, it also transformed a cheap little calculating aid into a piece of capital investment.

Now the all-new Sinclair Cambridge Programmable puts programmability where it belongs: in the palm of your hand, for less than \$30.

The features of the Sinclair Cambridge Programmable

The Cambridge Programmable is genuinely pocketable. A mere 4½" x 2", it weighs about 2oz.

Yet there is absolutely no compromise in the package of functions it offers.

Because the Cambridge Programmable is both a scientific calculator with memory, algebraic logic and brackets (which means you enter a calculation exactly as you write it), and a programmable calculator which offers simple, flexible through-the-keyboard program entry and operation.

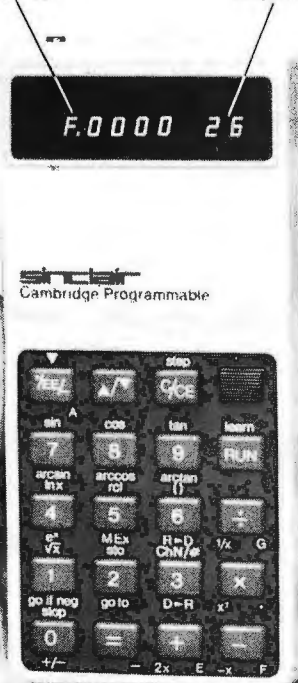
The Cambridge Programmable has a 36-step program memory, and features conditional and unconditional branch instructions (go to and go if negative).

There is also a step facility, which allows you to step through the program to check that it has been entered correctly. If there is any programming error, the learn key allows you to correct single steps without destroying any of the remainder of the program.

To achieve this, each program key-stroke has an identifying code, or 'check symbol'. (The symbols for the digit keys are the digits themselves, while the symbols for the operator keys are letters printed beside the keys.)

The check symbol for \square , for example, is F. So if, as you step through the program, the display shows

check symbol step number



it means that \square is programmed as step 26. If step 26 should have been \square , all you have to do is press



It's as simple as that!

These facilities make the Cambridge Programmable exceptionally powerful, whether it's running programs you devise for yourself or the programs in the Program Library.

Use the 294-program library to tailor the machine to your own specialty

Like a full-size computer – and unlike far more expensive specialist calculators – the Sinclair Cambridge Programmable can be programmed to handle calculations concerned with any specialty.

And of course, whatever it's doing the Programmable is error-free – in fact, once it's programmed, it can even be given to an operator who doesn't understand the program!

To save you time, and to help inexperienced programmers, Sinclair have produced a library of 294 programs ready to be entered straight into the calculator.



Using these standard programs, the Cambridge Programmable solves problems from quadratic equations (where the program gives both real and imaginary roots) to twin-T filter design, and from linear regression to bond yields. It even plays a lunar landing game! To realise the full power of the Cambridge Programmable, the Program Library is a must.

(The calculator is supplied with 12 sample programs, and full instructions for entering your own program. The four books in the program library are available at \$4 each, or \$10 for the complete set.)

Why the Cambridge Programmable costs so little

The Sinclair Cambridge Programmable uses the Sinclair talent for miniaturisation to the full – as you'd expect from the company that pioneered the truly pocketable pocket calculator, and recently introduced the world's first pocket TV.

Chip and circuitry design are unique to Sinclair, and the Cambridge Programmable is assembled by Sinclair's own staff at their headquarters plant. Shipped direct, and sold to you direct, the Cambridge Programmable accumulates no middleman's profits on the way.

The result is a pocket programmable calculator of advanced design, sold by the manufacturer with the manufacturer's own 1-year comprehensive guarantee, at a price unmatched by any comparable calculator.

10-day no-obligation offer

There's a lot more to this remarkable calculator than a brief written description can cover.

You need to see it and handle it... to program it yourself in a few seconds to save you hours... to check its performance against tables and graphs... to test the full range of programs available... to evaluate, perhaps, its use as an educational aid in developing a student's computer understanding.

So we're offering a 10-day trial. Send your check or money order with the order form below, and you'll receive a calculator direct. Use it for 10 days, and if you don't feel it's the finest \$29.95 you've ever invested, send it back. We'll refund your money without question.

There's nothing to lose, and so much calculating power to gain.

Post your order today.

sinclair

Sinclair Radionics Inc., Galleria,
115 East 57th Street, New York, N.Y. 10022 USA.
Tel: (212) 355 5005.

To: Sinclair Radionics Inc., Galleria, 115 East 57th Street, New York, N.Y. 10022, USA.

PE11

Please send me _____ (qty) Sinclair Cambridge Programmable(s) at \$29.95 each, including full instructions, and sample programs. \$ _____

Enclosed is check/MO payable to Sinclair Radionics Inc.

_____ (qty) AC line adaptor(s) at \$4.95 \$ _____

_____ (qty) Program Library Book 1 at \$4 \$ _____
General/Finance/Statistics
(percentage, metric system, memory, games, dates, finance, mortgages, statistics)

Name _____

_____ (qty) Program Library Book 2 at \$4 \$ _____
Mathematics
(algebra, calculus, geometry, trigonometry, number theory, transcendental functions)

Address _____

_____ (qty) Program Library Book 3 at \$4 \$ _____
Physics & Engineering
(astronomy, statics and dynamics, relativity, mechanics, properties of matter, fluids, structures, thermodynamics)

City _____

_____ (qty) Program Library Book 4 at \$4 \$ _____
Electronics
(networks, circuits, filters, electrodynamics, radiation and propagation)

State _____

_____ (qty) complete set(s) of 4 books at \$10 per set \$ _____

Zip _____

Sales tax (NY residents) \$ _____

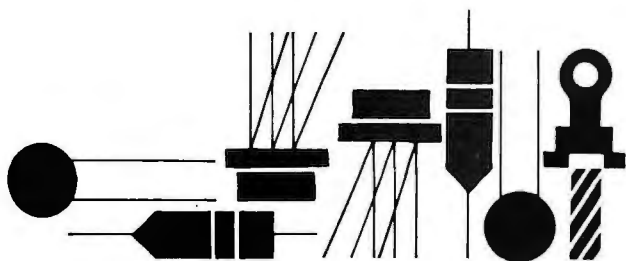
(PLEASE PRINT)

Post and packing \$ 2.50

Total \$ _____

I understand that you will refund purchase price in full if I return calculator(s) and accessories in saleable condition within 10 days of receipt.

Signature _____



Solid State

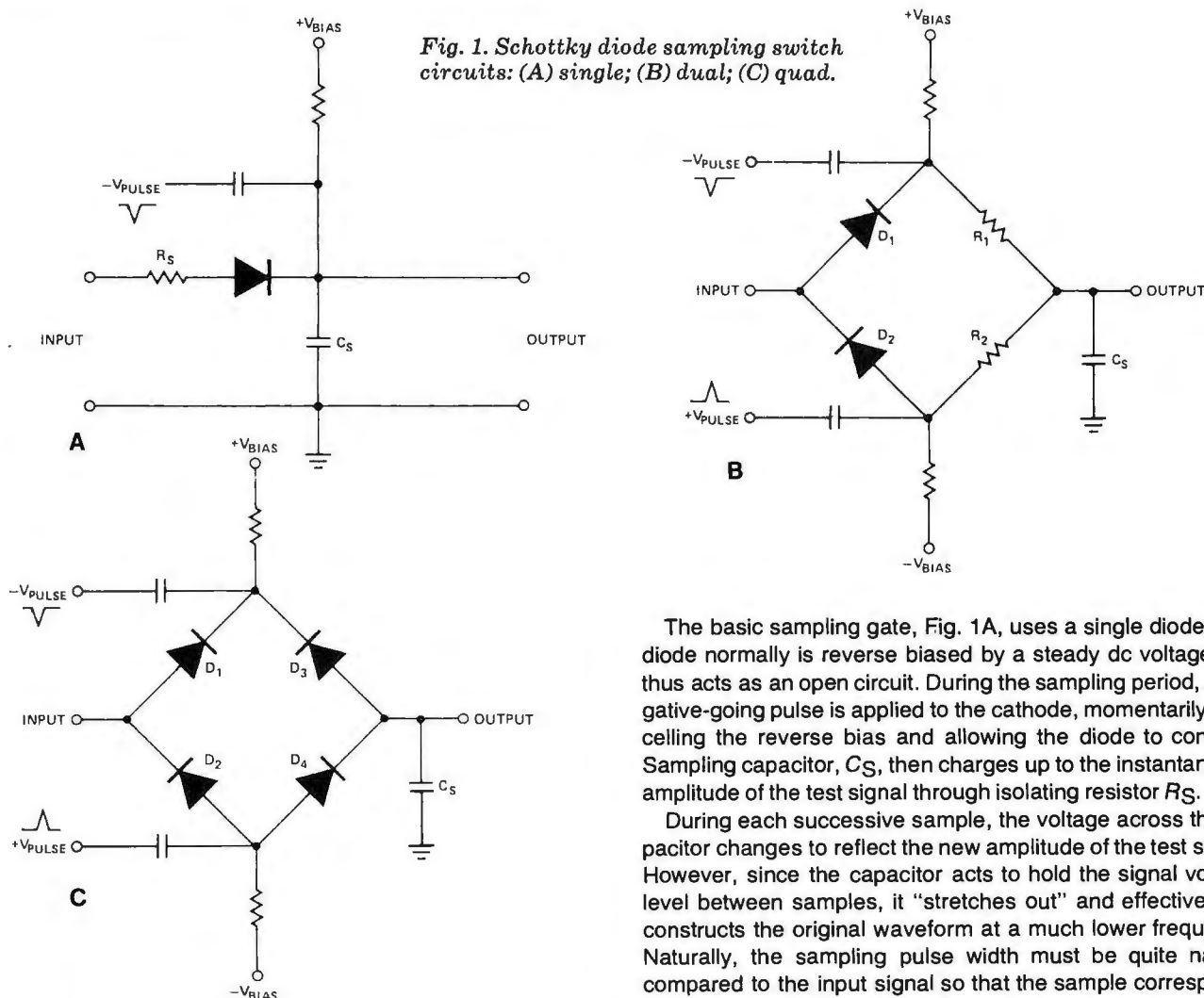
By Lou Garner

BACK TO THE (CIRCUIT) MINES

READER response to my prospecting trip among the circuit mines of manufacturers' literature in the August issue (*A Circuit Medley*) has been so gratifying that I've decided to pay a return visit to the "diggings." The results of my latest expedition are shown in Figs. 1 through 4. Like the circuits discussed previously, these nuggets are, of course, but a minuscule sampling of the thousands of designs suggested in manufacturers' periodicals, product bulletins, catalogs, application notes, data sheets, brochures, and reference handbooks. The major sources for circuits, naturally, are the publications released by the semiconductor manufacturers, but other component manufacturers—particularly those offering more expensive components such as transducers, transformers, and relays—are excellent secondary sources of information.

Intended for use as sampling gates, the Schottky diode switching circuits in Fig. 1 were abstracted from Application Bulletin 16, published by Hewlett-Packard Components (640 Page Mill Road, Palo Alto, CA 94304). Sampling is essentially a time-stretching technique by which a high-frequency, repetitive signal is duplicated at a lower frequency to permit observation and/or measurement with standard test instruments, such as an oscilloscope or vector voltmeter. The gates sample the instantaneous amplitude of the test signal at different points on successive cycles until the original waveform can be reconstructed. Depending on the sampling rate, as compared to the frequency of the test source, the reconstructed waveform may have an equivalent frequency one-tenth or less than that of the original.

Fig. 1. Schottky diode sampling switch circuits: (A) single; (B) dual; (C) quad.



The basic sampling gate, Fig. 1A, uses a single diode. The diode normally is reverse biased by a steady dc voltage and thus acts as an open circuit. During the sampling period, a negative-going pulse is applied to the cathode, momentarily cancelling the reverse bias and allowing the diode to conduct. Sampling capacitor, C_S , then charges up to the instantaneous amplitude of the test signal through isolating resistor R_S .

During each successive sample, the voltage across the capacitor changes to reflect the new amplitude of the test signal. However, since the capacitor acts to hold the signal voltage level between samples, it "stretches out" and effectively reconstructs the original waveform at a much lower frequency. Naturally, the sampling pulse width must be quite narrow compared to the input signal so that the sample corresponds to a specific portion of the applied waveform. Also, the capaci-

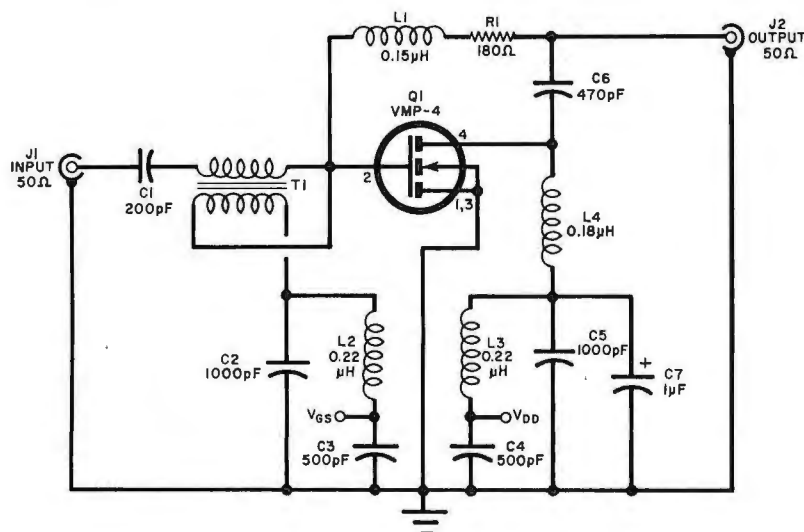


Fig. 2. This broadband vhf amplifier circuit, using a VMP-4 FET has a reasonably flat frequency response from 40 to over 200 megahertz.

tor's charging time must be short enough to charge or discharge during this interval.

Although the basic single-diode sampling gate provides acceptable performance in some applications, it has a number of limitations. If the isolation resistor, R_S , is made too small, it is relatively ineffective. If it is too large, it reduces efficiency by introducing an excessive voltage drop and increasing the charging time constant. There is always the problem of the reverse bias developing a steady charge on the sampling capacitor. These limitations can be reduced somewhat by using a symmetrical dual diode sampling gate, as shown in Fig. 1B. Here, the diodes are arranged to form a bridge in conjunction with two fixed resistors, R_1 and R_2 . Equal, but opposite, reverse bias voltage sources are required and both positive- and negative-going sampling pulses must be used to initiate operation. Superior to the single diode sampling gate, the dual diode design is also relatively inefficient due to the voltage drops across the bridge resistors.

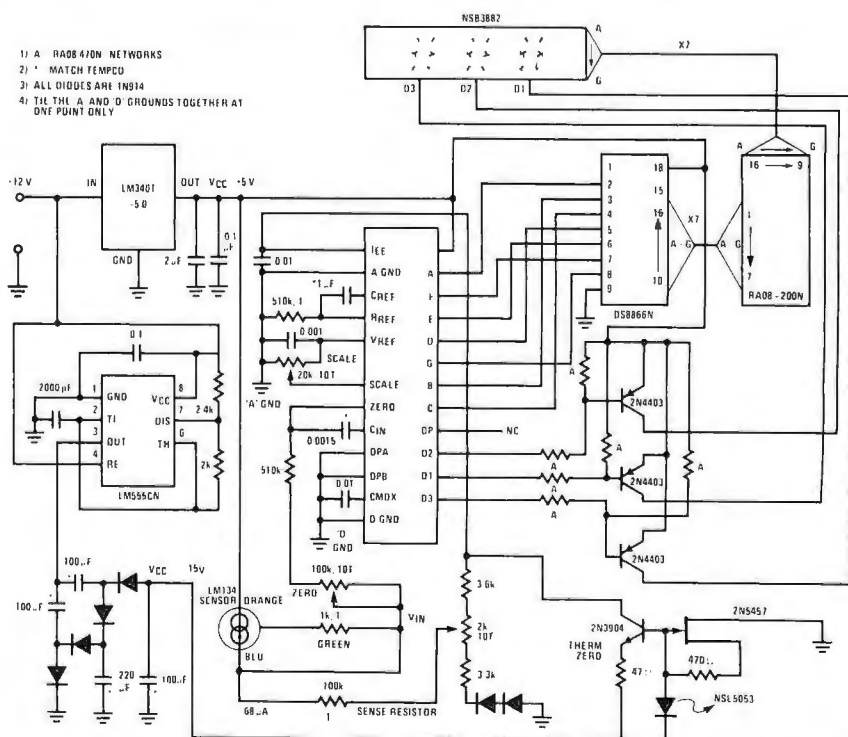
The most efficient design as well as the most common in commercial equipment is one using four diodes arranged in a

full-wave bridge, as illustrated in Fig. 1C. For optimum performance, the four diodes must have matched characteristics, the two reverse bias voltages must be equal and opposite, and the control signals must be identical in waveform except for polarity. The value of the reverse bias voltage is somewhat critical in that it must be large enough to prevent input signals from driving the diodes into conduction, yet small enough to permit the gating control pulses to forward bias the diodes during the sampling interval.

Typical Schottky diodes suitable for use in these circuits are the 1N6263 and HSCH-1001, or, for the bridge circuit, the HSCH-1004, 5082-2805, and 5082-2813 diode arrays. In practical systems, the sampling gate generally is placed between the input signal source and the following amplifier's input capacitor.

Included in the 4-page technical data bulletin for the VMP 4 MOSPOWER™ FET manufactured by Siliconix, Inc. (2201 Larelwood Road, Santa Clara, CA 95054), the broadband vhf amplifier circuit shown in Fig. 2 offers a reasonably flat response from 40 to over 200 MHz. With power gains approach-

Fig. 3. Digital thermometer circuit uses an LM134 programmable current source as temperature sensor, a 2½-digit DPM chip for A/D conversion and display decoding, and an NSB3882 readout driven by a DS8866N and three 2N4403 pnp transistors.



ing 15 dB, it can deliver from a few milliwatts to several watts output, depending on the dc supply voltage and drive signal amplitude.

Standard components are used in the design, with all capacitors good-quality ceramics or micacs except for C7, which is a 50-V tantalum unit. The broadband input r-f transformer, T1, consists of 4 turns of #22 AWG twisted pair on an Indiana General type F625-902 core. Naturally, layout and lead dress are somewhat critical and good vhf wiring practice must be followed for optimum performance. A 24-volt dc source is used as the amplifier's power supply, with the gate bias voltage (VGS) adjusted for the minimum drain current to meet power output requirements within Q1's maximum ratings. Supplied in a four-terminal, flange-mounted strip-line package, the VMP4 transistor (Q1) is an n-channel, enhancement-mode MOSFET with a maximum drain-source breakdown voltage rating of 60 volts, a maximum drain current rating of 1.6A, and a maximum power dissipation (at 25°C) of 35 watts.

Suitable for use either in hobbyist or commercial designs, the digital thermometer circuit in Fig. 3 is one of a number of items in a recent issue of the *National Anthem*, a publication issued periodically by the National Semiconductor Corporation (2900 Semiconductor Drive, Santa Clara, CA 95051). Using an LM134 programmable current source as its temperature sensor, the instrument features an ADD2500 2½-digit DPM chip for analog/digital conversion and display decoding and an NSB3882 readout driven by a DS8866N and three 2N4403 npn transistors. Two RA08 resistor networks are used in the circuit in addition to quarter-watt fixed resistors and small potentiometers. Requiring a single unregulated 12-volt dc source, the design includes an LM340 3-terminal, 5-volt regulator and a dc/dc converter consisting of an LM555 and a four-diode rectifier network. The converter drives a negative current regulator comprising an NSL-5053 LED, a 2N3904 npn transistor, and a 2N5457 FET. Although neither parts placement nor wiring dress are critical, good layout and wiring techniques should be observed when duplicating the circuit. If desired, the LM134 may be used for remote sensing.

Described by Hans Palouda in Volume 4, Number 2, of *Progress*, a bimonthly journal published by the Marketing Services Department of the Fairchild Camera and Instrument Corporation's semiconductor operations (464 Ellis Street, Mountain View, CA 94042), the complementary audio power amplifier circuit in Fig. 4 features inexpensive, TO-220 monolithic Darlington transistors (types SE9301 and SE9401) in its output stage. Because of the inherent high gain of the Darlington units, only one other transistor, Q1, is needed to complete the design. Designed for operation on a 40-volt single-ended supply, the circuit offers an input impedance of 10,000 ohms. Requiring an input signal of only 1.2 V rms to deliver a full 20 watts output to a matched 8-ohm load, it can be used with any standard preamplifier. According to Fairchild, the amplifier's frequency response is essentially flat within 1 dB from 30 Hz to 200 kHz, while its harmonic distortion is typically less than 0.2%. In operation, Q1's base serves as the tie point for both ac and dc feedback as well as for signal input. A bootstrap circuit is used to boost Q1's effective collector voltage, insuring an adequate drive signal for Q2 and developing a constant voltage across R7, which acts as a current source and, in conjunction with diodes D1, D2, and D3, serves to reduce low-level crossover distortion.

While any standard construction technique can be used, a suitably designed etched circuit board is easiest, provided reasonable care is exercised in developing a clean layout. Dc polarities must be observed, of course, and heat sinks should



MAKE GREAT CONNECTIONS!



IC SOCKETS

3 Level Wire Wrap Gold	1-9	10-24	25-100
14pin	.38	.37	.36
16pin	.42	.41	.40
18pin	.73	.65	.59
24pin	1.00	.91	.83
40pin	1.69	1.51	1.37

Low Profile D.I.P., Solder tail, (TIN)

1-9	10-24	25-100
8 pin	.15	.14
14pin	.18	.17
16pin	.20	.19
18pin	.27	.26
22pin	.29	.28
24pin	.35	.34
26pin	.36	.35
28pin	.42	.41
40pin	.60	.57

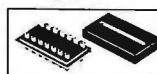


IC INTERCONNECT ASSEMBLIES

26 Ga. Ribbon Cable

MORE for your money!

DUAL-IN-LINE PLUGS



Use for mounting diodes, resistors, capacitors, etc.

PLUGS	1-24	25-49	1-24	25-99
8 pin	.46	.39	.10	.09
14 pin	.48	.40	.10	.09
16 pin	.56	.47	.10	.09
24 pin	.79	.72	.15	.13
40 pin	\$1.23	\$1.08	.25	.22



S-100 BUS (2 X 50) CONNECTORS

Highest quality connectors for the popular S-100 bus card edge systems. 2 x 50, .125" pin spacing with .25" row spacing for IMSAI and most other machines. Will not fit ALTAIR. Available in gold or NASGLO finish. NASGLO is a new tin-nickel process which has contact properties similar to precious metal. Bodies are rugged polyester, not Bakelite as in some connectors.

Our solder-tail sockets have heavy square pins. No fold-over problem on insertion.

PCC-100WW-G....(Gold, wire wrap).....	\$4.50, 4 for \$17.00
PCC-100ST-G....(Gold, solder tail).....	\$4.50, 4 for \$17.00
PCC-100WW-N....(NASGLO, wire wrap).....	\$3.75, 4 for \$14.00
PCC-100ST-N....(NASGLO, solder tail).....	\$3.75, 4 for \$14.00



POSITIVE	NEGATIVE	3-TERMINAL
7805	7905	VOLTAGE REGULATORS.
7806	7906	1A
7808	7908	In TO-220
7812	7912	95¢ - 5/\$4.50!
7815	7915	



50V, 3Amp Epoxy Bridge
Repeat of popular sell-out. Heavy silver leads.
BR-503.....79¢



tri-tek, inc.
7808 NORTH 27 AVE.
PHOENIX, ARIZONA 85021
MASTER CHARGE/BAC (602) 995-9352

Minimum Order, USA, \$10
Foreign, \$15 in US Funds.
Surface Shipping Prepaid.
Add 50¢ insurance

SEND FOR FREE CATALOG

CIRCLE NO. 60 ON FREE INFORMATION CARD

computer depot inc. T.M.

555 7TH STREET • MINNEAPOLIS, MN 55435 • (612) 927-5601

- ☐ The Design of Active Filters with Experiments \$7.95
- ☐ 555 Timer Applications Source Book With Experiments \$6.95
- ☐ Computer Technicians Handbook \$8.95
- ☐ Galaxy Game for the 6800 \$14.95
- ☐ Handbook of Operational Amplifier Circuit Design \$24.50
- ☐ Microcomputer Handbook Suppl \$19.95
- ☐ How to Program Microcomputers \$8.95
- ☐ Speech Lab. Assembled and Tested \$299.95
- ☐ B&K Model 501A Semiconductor Curve Tracer \$182.00 List \$150.00 Sale
- ☐ LumaGlo Swivel Lamp Best for Electronics \$17.95
- ☐ Free Catalog

Name: _____

Address: _____

Bank Americard / Mastercharge No. _____

Expiration Date: _____

Interbank Number: (M/C only) _____

Signature: _____

CIRCLE NO. 10 ON FREE INFORMATION CARD



Get This Heathkit Catalog



New GD-1110 Pinball Game

The incredible Bally Fireball® pinball game you've been hearing about now in low-cost easy-to-build kit form. One to four players can play this exciting game that's so challenging its impossible to grow tired of. Solid-state electronics and computer technology replace much of the failure-prone electromechanical devices found in other games. The GD-1110 is not a toy but a sophisticated pinball game that will give you years of fun and action.

Only \$599.95



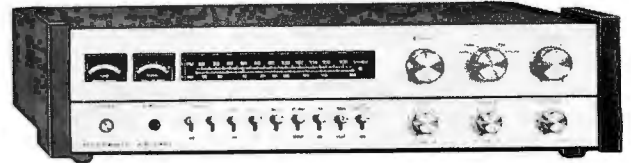
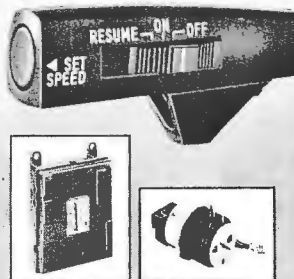
New 5280 Series Test Instruments

Here are five new starter instruments intended for (but not limited to) the beginner. You'll be surprised at the features and performance these new instruments have. There's the IG-5280 RF Oscillator with 1000 Hz audio output, the IM-5284 high performance multimeter that reads volts, ohms and DC current, the IT-5283 Signal Tracer for RF, AF and logic tracing, the IB-5281 RCL Bridge for design and experimentation and the IG-5282 Audio Oscillator with a 10 Hz to 100 kHz frequency range. And to power the 5280 series, you can build the IPA-5280-1 power supply. Only \$37.95 each

New CS-1048 Cruise Control

You'll appreciate the CS-1048 every time you take a long trip in your car. Just preset your cruise speed and the CS-1048 does the rest electronically. Maintains your car's speed and improves mileage too.

Only \$79.95



New AR-1429 Stereo Hi-Fi Receiver

This year give symphonies, cool jazz, and the driving beat of rock with this stereo performer from Heath. 35 watts, minimum RMS, per channel into 8 ohms with less than 0.1% total harmonic distortion from 20-20,000 Hz. The AR-1429 is perfect for the budget conscious stereo buff who requires a high quality system. It has all the features of a high-priced receiver and the performance too. Phono hum and noise are -65 dB. FM sensitivity is 1.8 μ V. Provision for optional Dolby® FM module. Like all Heathkit products, assembly is quick and easy. Only \$319.95



New GD-1186 Digital Electronic Scale

Unique and functional truly describe the new Digi-Scale electronic "weighing machine". Big, bright LED's show your weight with more precision than normal scales and there are no springs or weights to compromise performance. The digital readout may be mounted on the wall or just about anywhere.

Only \$99.95

New TO-1860 Heath/Thomas Organ

Microprocessor-based organ has nine preassembled and tested circuit boards for really easy assembly! Color-coded keys and coordinated music make learning to play a breeze. Single-finger chords, automatic rhythms and 17 different instrument voices add real versatility.

Only \$1749.95



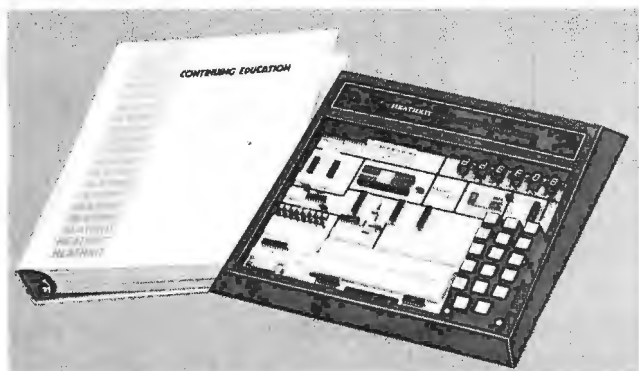
Read about these and nearly 400 other exciting kits in our new FREE Catalog

of Truly Unique Gift Ideas!



New GC-1107 Digital Alarm Clock

A perfect kit for the first time kitbuilder. This super-accurate timepiece has an attractive blue four-digit display that dims automatically according to ambient light. It also has the features you need in a clock; 24-hour "smart" alarm, snooze switch, alarm-on indicator and power failure indicator. Only \$27.95



New Microprocessor Self-Instruction Course

Our EE-3401 Microprocessor Operation and Programming Course (\$89.95) is your key to the power of microprocessor operation and programming. Features Heath's famous individualized learning techniques to provide you with a thorough background in microprocessor operation, interfacing and programming. Accompanying software and hardware experiments provide "hands-on" experience with the companion ET-3400 6800 Microprocessor-based trainer (\$189.95).



New Heathkit Personal Computers

For the ultimate gift, there's a Heath Computer System. Destined to be the industry leaders, Heathkit computer products are the total system designs that excel in home, hobby, business and educational applications. Powerful software gets them up and running fast. Superior software, documentation and service support keep them that way.

- 1 H8 8080 8-Bit Digital Computer Kit
- 2 H11 LSI-11 16-Bit Digital Computer Kit
- 3 H9 Video Terminal Kit
- 4 H10 Paper Tape Reader/Punch Kit
- 5 LA36 DEC Writer II (Assembled)

Prices are mail-order net F.O.B. Benton Harbor, Michigan.
Prices and specifications subject to change without notice.

FREE!

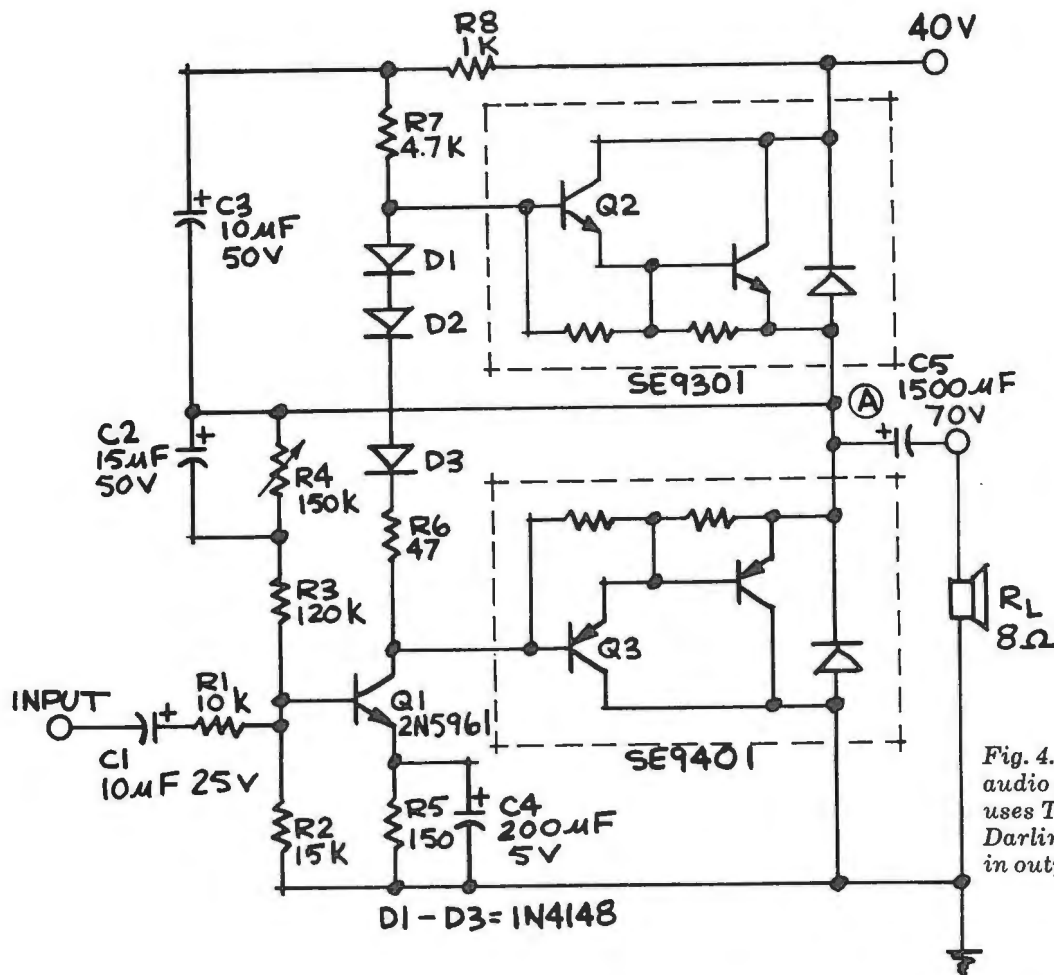
Nearly 400 fantastic kits you can build. Electronic kits for everyone. Stereo hi-fi, television, amateur radio, auto accessories and much, much more.

Heath Company, Dept. 010-350



Send for your Heathkit Catalog in time for Christmas Giving!

HEATH Schlumberger	Heath Company, Dept. 010-350 Benton Harbor, Michigan 49022
Please send me my FREE Heathkit Catalog. I am not on your mailing list.	
Name _____	
Address _____	
City _____	State _____
GX-337	Zip _____



be provided for the output Darlington, Q2 and Q3. After checkout, the center voltage at test point A is set by adjusting potentiometer R4. If desired, the basic design can be modified to provide output powers of up to 60 watts by using different output Darlington. More complete details are furnished in Fairchild's Application Note 334.

Readers' Circuits. The readily available 555 timer is among the most versatile of the special-purpose integrated circuits. It seems to have more applications than the proverbial dog has fleas. Hardly a week passes that one doesn't learn of some new application for this inexpensive and interesting device. The digital thermometer circuit discussed earlier (Fig. 3) had a 555 timer in its dc/dc converter and a number of readers have submitted circuits using this intriguing IC.

As an example, the dual-purpose timer circuit shown in Fig. 5 can be used either to energize or deenergize an external device for a preset, but adjustable, time interval, depending on which pair of output terminals is used. Contributed by reader A. R. Goldsworthy (14 Edgemont Rd., Braintree, MA 02184), the design requires a minimum of components. It can be assembled on either a perf or etched circuit board and can be operated on virtually any 6-volt dc power source, including series-connected flashlight or penlight cells. In operation, output 1 is energized and output 2 is deenergized when power is first switched on by S1. Depressing and releasing momentary contact pushbutton switch S2 will deenergize output 1 and energize output 2 for an interval proportional to the R1-C1 time constant. At the end of the time interval, output 1 will be reenergized and output 2 deenergized.

The current available from either output is adequate to trig-

ger an external control circuit, actuate a sensitive relay, power a small incandescent lamp (such as a #47 bulb) or LED. A 330-ohm current-limiting resistor should be used in series with standard LED's to prevent damage. With the component values specified, the maximum time delay is approximately 15 seconds, according to reader Goldsworthy. If desired, the timing interval may be increased by replacing C1 with a 25-μF, 50-μF, 100-μF, or even larger capacitor. The lower (minimum) time limit is determined by R1's adjustment and component characteristics.

A valuable accessory for both amateur and professional photographers, the automatic remote (slave) flash control circuit illustrated in Fig. 6 utilizes a 555 timer, a phototransistor, operational amplifier, and silicon controlled rectifier to achieve

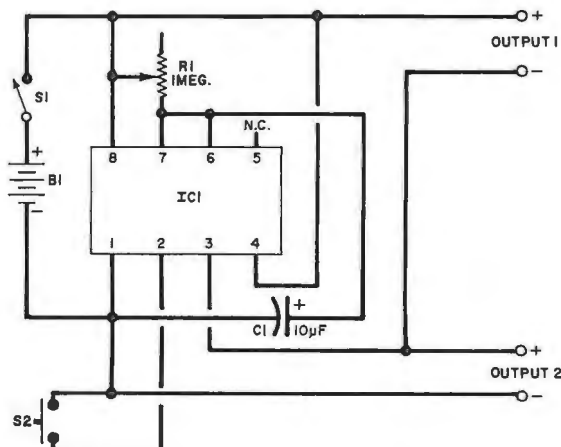


Fig. 5. Dual-purpose timer has preset interval.

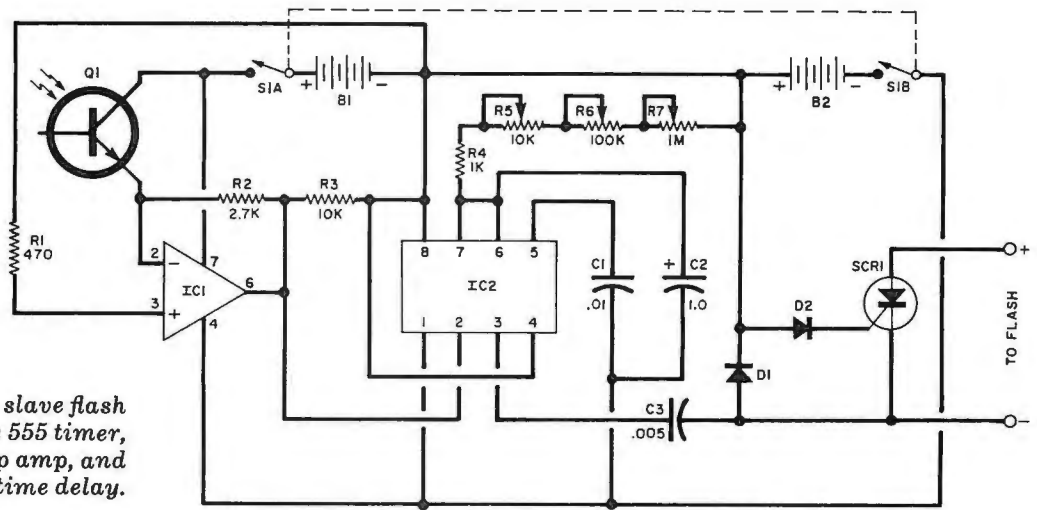


Fig. 6. Automatic slave flash control circuit uses 555 timer, a phototransistor, op amp, and SCR for adjustable time delay.

an adjustable time delay. Submitted by Richard C. Gribble (220 East First St., Kannapolis, NC 28081), who has employed several identical units for "stop motion" multiple-flash photography, the control can be used with any standard flash blub or electronic flash assembly. Light from the main flash striking phototransistor *Q1* delivers a pulse to op amp *IC1*. Amplified by *IC1*, this pulse is used to trigger the 555 timer, *IC2*. After a time delay determined by the *R4/R5/R6/R7-C2* time constant, *IC2* triggers the silicon controlled rectifier, *SCR1*, through coupling capacitor *C3*, switching this device to a conducting state and activating the external flash assembly. Circuit operating power is supplied by a pair of 9-volt batteries, *B1* and *B2*, controlled by dpst switch *S1*. Transistor *Q1* is a type FP100 or FPT100 phototransistor; *IC1* a 741 op amp; *IC2*, of course, a "555" timer; diodes *D1* and *D2* type 1N4005, and *SCR1* any standard 400-V, 1.5-A unit. Except for potentiometers *R5*, *R6* and *R7*, all resistors are quarter- or half-watt types, while *C1* and *C3* are ceramic disc; and *C2* a 10-V tantalum capacitor. Although Richard assembled his original models on perf board, other construction techniques can be used for duplicating the circuit provided all dc polarities are observed and professional assembly and wiring procedures are followed. With the parts values indicated, the time delay can be adjusted from (approximately) 1 millisecond to 1.1 seconds, with *R5*, *R6* and *R7* used to set the delay in thousandths, hundredths, and tenths of a second, respectively.

Where several controls are used simultaneously for multiple exposure stop-motion flash photography, each unit is adjusted for successively longer delays. Naturally, the photographer must take the flash duration into account which, although relatively short for electronic units, can range up to several milliseconds for flashbulbs. If flash units with different guide numbers are used, the distances to the subject must be adjusted to achieve the correct illumination for the f-stop employed. With a little practice and experimentation, however, quite professional results can be achieved, even using relatively inexpensive cameras and flash assemblies.

Device/Product News. With an eye on the booming home security market, Siliconix, Inc. (2201 Laurelwood Road, Santa Clara, CA 95054) has recently introduced a pair of smoke detector integrated circuits. Designated as types SM110 and SM120, the new units are monolithic bipolar-PMOS devices packaged in standard 14-pin DIP's. With low standby supply current requirements to insure long battery life (typically, 1 year), the two units feature on-chip MOSFET in-

put comparators and will interface directly with ion chamber as well as photoelectric detectors. Both include low battery detection and reverse polarity protection circuits, adjustable trip points, provision for either latching or nonlatching alarm modes, and can supply output currents up to 30 mA to external discrete horn drivers. The SM110 is designed primarily for operation on 9-volt dc sources while the SM120 is designated for operation on 10-to-13-volt supplies.

If you'd like to be in tune with electronic musical instruments, then you'll be interested in a new 7-stage counter integrated circuit announced by Fairchild's Linear Division (464 Ellis St., Mountain View, CA 94042). The new device, type F4727, is designed to generate all of the tones of the chromatic scale across eight octaves of the musical spectrum. Based on a primary chromatic scale, the IC can generate each of the twelve flats, sharps and natural notes of the seven additional octaves of the primary scale. Twelve type 4724 devices can cover the entire musical spectrum.

For CB enthusiasts, The Exetron Division of Fairchild (3105 Alfred St., Santa Clara, CA 95050) is now offering an IC citizen's band radio controller that combines channel selection with automatic scanning and a drive for 7-segment displays. The new unit, type FCB8010, is programmable for use with domestic 40-channel CB transceivers and can furnish either serial or parallel BCD coding for channel selection, eliminating the need for a BCD-coded rotary switch. It also can provide externally selectable search and scan modes, as well as increment up or down modes. The search mode is selectable for either busy or vacant channels, while the scan mode will remain on a busy channel for three seconds before advancing to the next busy channel. Slow up or down operates at two channels per second, increasing to six channels per second starting with the third channel. Emergency channel 9 is externally selectable for immediate reception, but transmitting on channel 9 is inhibited unless specifically selected.

Teledyne Semiconductor (1300 Terra Bella Ave., Mountain View, CA 94043) has expanded its line of monolithic data conversion products with the addition of three new A/D converters featuring three binary outputs. Type numbers are 8703CJ, 8704CJ, and 8705CN for the 8-, 10-, and 12-bit devices, respectively. All three devices utilize low-power CMOS technology and are fully self-contained in single 24-pin DIP's, requiring only passive support components. Conversion speed is 1 to 20 ms. The three-state binary output (latched) makes the units ideal for direct microprocessor interfacing and for multiplexing the outputs of multiple A/D converters. ◇

Popular Electronics Reprint series

Many important articles covering a variety of interests in the broad field of electronics are published in POPULAR ELECTRONICS. Reprints of selected articles and test reports are now available in the event that you missed some you would like to have for reference or study purposes—or for projects you wish to build. Reprints in this series are only \$1 each (*75¢ for those marked with an asterisk.) Minimum order is \$2.

SPECIAL ARTICLES

AUDIO

1. How The New FTC Hi-Fi Rules Affect You
2. How To Evaluate Tape Recording Specs
3. A New Standard For FM Tuner Measurements

COMPUTER

7. How To Select A Microcomputer
 8. Ins & Outs Of Computers For Beginners
- COSMAC "ELF" SERIES (Reprint #'s 4, 5, 6, & 17)
4. Low Cost Experimenter's Microcomputer
 5. Experimenter's Microcomputer/With Hardware Improvements & More Programming Details
 6. Microcomputer/How To Expand Memory, Plus More Programs
 17. Build The Pixie Graphic Display

CB RADIO

9. CB Specifications Made Easy
10. How To Choose CB Base Station Antennas

OTHER

14. How To Design Your Own Power Supplies
 15. The Care & Feeding Of NiCd Batteries
 16. Build A Gas & Fume Detector
- LEARNING ELECTRONIC THEORY WITH CALCULATORS SERIES (Reprint #'s 11, 12, & 13)
11. Basic Equations and OHM's Law
 12. Reactance, Time Constants And AC Calculations
 13. RC Coupling, Basic Amplifier Calculations, and RLC Relationship

TEST REPORTS

AUDIO

18. ADC Accutrac 4000 Record Player
- 19.*Empire Model 698 Manual Turntable
20. Kenwood Model 600 Integrated Stereo Amplifier
- 21.*MXR Stereo Graphic Equalizer

- 22.*Nakamichi Model 500 Stereo Cassette Deck
23. Onkyo Model TX-4500 AM/Stereo FM Receiver
- 24.*Ortofon MC20 Moving Coil Phono Cartridge
- 25.*Pickering Model XV-15/625E Stereo Phono Cartridge
26. Pioneer Model CT-F8282 Stereo Cassette Deck
27. Radio Shack "Realistic" Model STA-2000 AM/Stereo FM Receiver
28. Rotel RX-7707 AM/Stereo FM Receiver
29. Sansui Model TU-9900 AM/Stereo FM Tuner
- 30.*Shure Model M24H Stereo Phono Cartridge
- 31.*Sony Model TA-4650 V-FET Stereo Power Amplifier
- 32.*Spectro Acoustics Model 210 Stereo Graphic Equalizer
- 33.*Stanton Model 681EEE Stereo Phono Cartridge
34. Teac Model PC-10 Portable Stereo Cassette Deck
- 35.*Technics Model SB-6000A Linear Phase Speaker System
- 36.*Thorens Model TD-126C Record Player

COMMUNICATIONS

- 37.*Cobra Model 29XLR 40-Ch. AM CB Mobile Transceiver
- 38.*Drake Model SSR-1 AM/SSB Communications Receiver
- 39.*Kenwood Model TS-820 Amateur Radio Transceiver
- 40.*Kris Model XL-50 40-Ch. AM CB Mobile Transceiver
- 41.*President Model "Washington" 40-Ch. AM/SSB CB Base Station
42. Yaesu Model FRG-7 AM/SSB Communications Receiver

TEST INSTRUMENTS

- 43.*B&K-Precision Model 280 Digital Multimeter
- 44.*B&K-Precision Model 1471B Dual-Trace Scope
- 45.*Ballantine Model 1010A Dual-Trace Scope
- 46.*Fluke Model 8020A Digital Multimeter
- 47.*Hewlett-Packard Model 280 Digital Multimeter
- 48.*Sencore Model DVM-32 Digital Multimeter
- 49.*Sencore Model TF-70 Portable Transistor Tester
- 50.*Triplet Model 60 Analog Multimeter

*REPRINTS MARKED WITH ASTERISK 75¢; ALL OTHERS \$1.00. MINIMUM ORDER \$2.00.

Popular Electronics Information Center, Consumer Products Division, 595 Broadway, New York, N.Y. 10012.

Please send the reprints listed below:
75¢ Each

\$1.00 Each

Reprint #	Quan.	Reprint #	Quan.

Reprint #	Quan.	Reprint #	Quan.

NUMBER OF REPRINTS ORDERED:

@ 75¢ _____ @ \$1.00 _____

TOTAL ENCLOSED \$ _____

(MINIMUM ORDER \$2.00)

Print Name _____

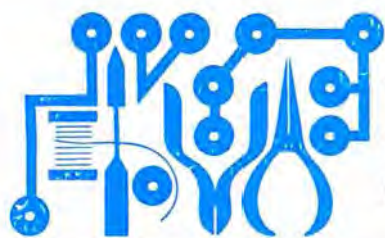
Address _____

City _____

State _____ Zip _____

*Residents of CA, CO, FL, IL, MI, MO, NY STATE, DC and TX add applicable sales tax. Outside U.S.A. add \$1.00 per order.

PE-117



Experimenter's Corner

By Forrest M. Mims

PROGRAMMABLE READ-ONLY MEMORIES

SEMICONDUCTOR memories are among the most important electronic circuits. They are found in almost all digital devices, ranging from pocket calculators to computers. Besides their obvious application in the storage of information, these memories can be used in the synthesis of unusual waveforms, music, and even human speech.

There are two basic types of semiconductor memories. *Read-only memories* (ROM's) are those from which data is normally only retrieved. *Read/write memories* (R/W's) or *Random-access memories* (RAM's) are those into which data can be loaded or from which information can be retrieved, each with equal facility. ROM's are factory programmed with fixed data which cannot be changed.

Some ROM's, called PROM's, can be permanently programmed by the user. Others, called EPROM's, can be programmed by the user and then erased by exposure to ultraviolet light. After

erasure, EPROM's can be reprogrammed. RAM's can be loaded with information, read, or reloaded electronically, depending on the logic states of the memory cell's READ and WRITE control lines.

Both types of semiconductor memories store information in the form of binary digits, abbreviated as bits, which have two possible states—logic 0 or logic 1. The stored data can be arranged as hundreds or even thousands of bits or combinations of bits called words. Words comprising four bits (*nibbles*) or eight bits (*bytes*) are the most common, but many other word lengths are also used.

Programmable Diode ROM's. An excellent way for the novice to learn more about ROM's is to assemble a programmable ROM or PROM that uses diode memory elements. A PROM of this type consists of a grid or array of input and output wires called *lines*. A logic 1 is loaded into the ROM by bridging the intersection of an input and output line with a diode. The absence of a diode at an intersection yields a logic 0.

You can use a simple diode PROM to simulate logic gates and combinational logic networks. The first step in designing a PROM for this purpose is to write

the truth table for the gate you want to simulate. The truth table for a two-input NAND gate, for example, is

	Inputs		Output
	A	B	
0	0	0	1
1	0	1	1
2	1	0	1
3	1	1	0

This truth table has four possible input combinations and only one output for each set of inputs. Therefore, our PROM will be a 4 by 1 grid of lines as shown in Fig. 1. The truth table is loaded (programmed) into the PROM by placing a

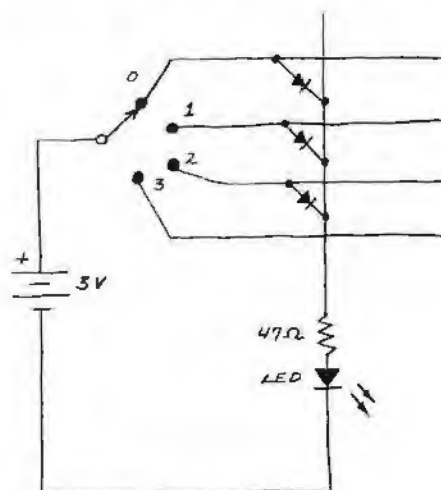


Fig. 3. Circuit to demonstrate the PROM in Fig. 2.

diode at the intersection of the output line and the line for each input, which results in a logic-1 output. The programmed array is shown in Figure 2. Figure 3 shows how to demonstrate the operation of the PROM with the help of a

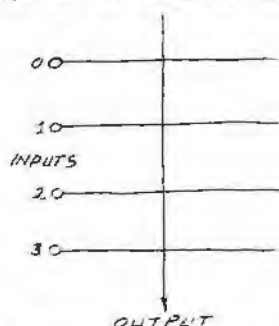


Fig. 1. PROM grid that can be used to simulate a NAND gate.

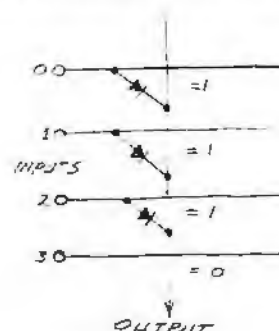


Fig. 2. 4X1 PROM programmed for 2-input NAND gate.

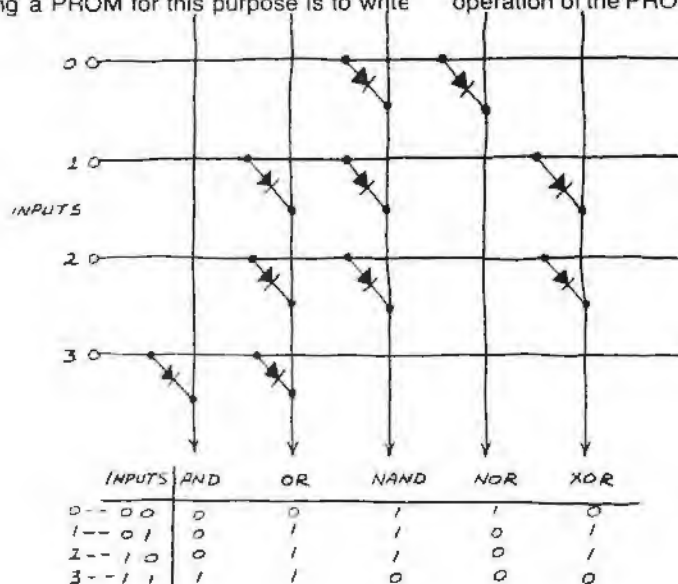


Fig. 4. Multiple function diode PROM.

battery, a LED, and a four-position switch.

Of course, our simple PROM version of the NAND gate is a trivial example of a read-only memory application. This is particularly true because the diodes aren't even necessary! Logic 1's can be represented simply by connecting the appropriate input lines to the output line. However, diodes are essential when the PROM becomes more sophisticated. For example, Fig. 4 shows a diode PROM that simulates the AND, OR, NAND, NOR, and EXCLUSIVE OR gates. Mass confusion would result without diodes because electrical current would thread its way through the wrong sections of the PROM via *sneak paths*. Diodes eliminate sneak paths because they pass current in only one direction.

Diode PROM Character Generator. Do you want to gain some hands-on experience with PROM's? Then invest some spare time and about three dollars building the diode PROM shown in Fig. 5. This simple PROM is connected as a seven-segment character generator. It allows you to generate up to ten characters including the digits 0 through 9, many letters of the alphabet, and a variety of unusual symbols.

NOW FROM BELL & HOWELL SCHOOLS! ALL NEW SELF-STUDY PROGRAM ON MICRO-PROCESSING

Completely up to date, thoroughly practical. Designed for professionals (engineers, technicians or advanced hobbyists) who need ready answers to basic programming concepts and troubleshooting techniques in microprocessing systems.

No classes or seminars to attend. You study at your own pace. Each segment is presented in a way that communicates practical, usable facts . . . stimulates new thinking, new ideas. Self-grading quiz at the end of each segment reinforces the major points learned. Developed and compiled through the resources of the world-famous educational division of Bell & Howell.

Send for complete facts. No salesman will call.

BELL & HOWELL SCHOOLS

Write: Bell & Howell Schools
2201 West Howard Street
Evanston, Illinois 60202

Send me complete facts on Microprocessing Self-Study Program. No obligation. No sales calls.

Name _____

Address _____

City _____

State _____ Zip _____

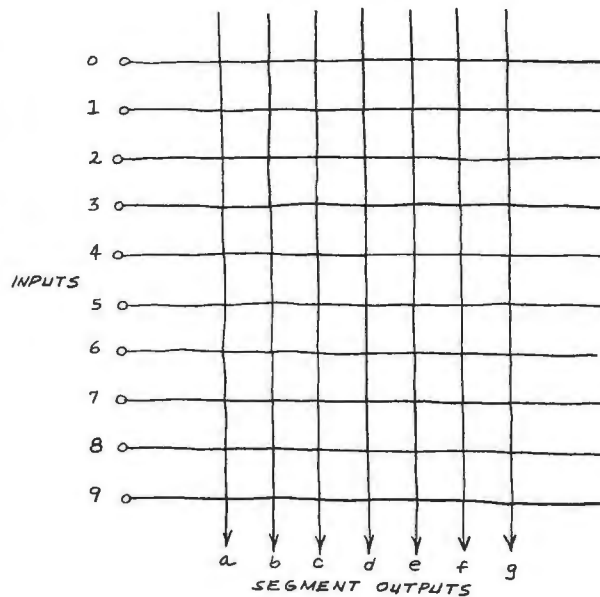


Fig. 5. Seven-segment display character generator diode PROM.

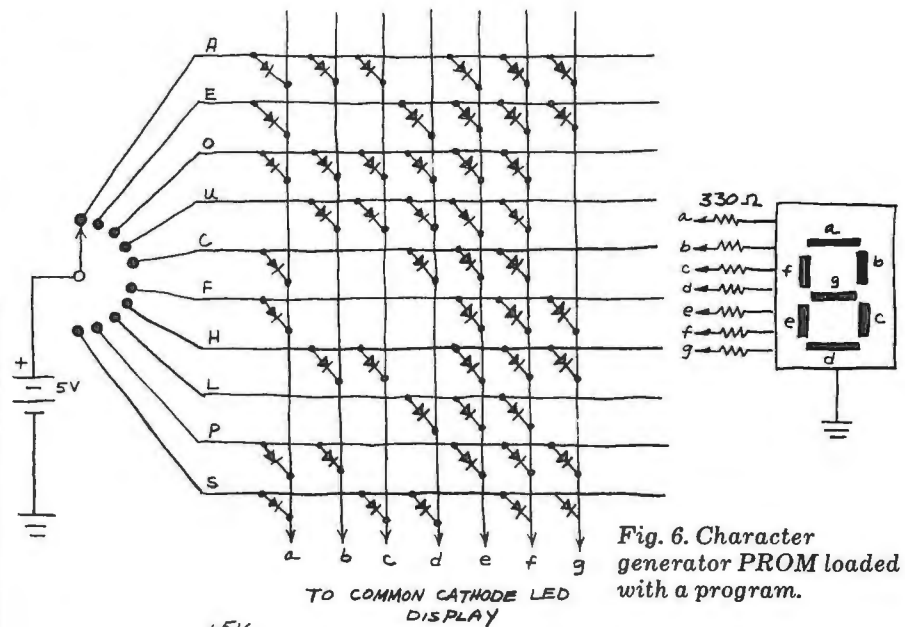


Fig. 6. Character generator PROM loaded with a program.

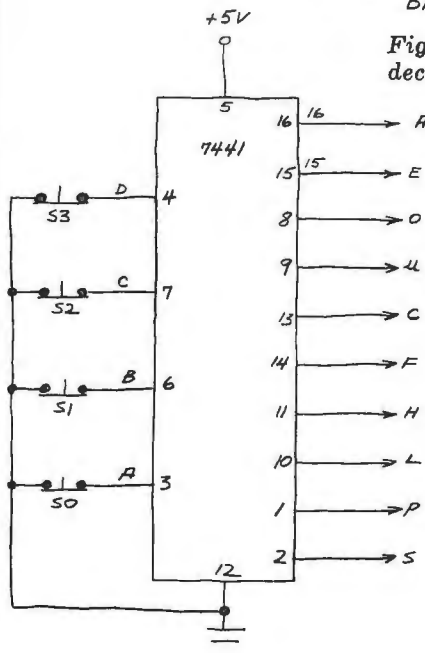


Fig. 7. Adding a decoder to the PROM.

NOTE:

1. REVERSE POLARITY OF DIODES IN PROM
2. USE COMMON ANODE LED DISPLAY

S0-S3:
SWITCH ON = LOGIC 0
SWITCH OFF = LOGIC 1

Even if this is your first experience with a PROM, you'll find programming very easy. Suppose you want a display that can flash words made from the characters A, E, O, U, C, F, H, L, P, and S. This assortment of vowels and consonants can generate a surprising number of words—HELP, POLE, PULL, HOLE, COOL, SELL, CAP, etc. First, you write a truth table that shows the segments of

the display that must be illuminated to produce each character.

Character	Segments									
	a	b	c	d	e	f	g			
A	1	1	1	0	1	1	1			
E	1	0	0	1	1	1	1			
O	1	1	1	1	1	1	0			
U	0	1	1	1	1	1	0			
C	1	0	0	1	1	1	0			
F	1	0	0	0	1	1	1			
H	0	1	1	0	1	1	1			
L	0	0	0	1	1	1	0			
P	1	1	0	0	1	1	1			
S	1	0	1	1	0	1	1			

This prom has ten input and seven output lines, so it requires a grid of 10 by 7 wires. The PROM is programmed by inserting a diode at the intersection of each character and segment line where a logic 1 exists in the truth table (Fig. 6). Simple, isn't it? If you're not convinced, try designing the same character generator with logic gates!

We can improve the character generator PROM by replacing the manual selector switch with a BCD-to-decimal decoder. True, this adds an IC, but reduces the number of input lines from ten to four and makes it possible to interface the PROM with other circuits. Figure 7 shows how the decoder is connected to the PROM.

You can assemble a working version of this diode PROM on a perforated board. Insert flea clips at each bit position and run the input and segment lines on opposite sides of the board to prevent shorts. The flea clips will allow you to insert and remove diodes. If you want to go first class, permanently wire a diode in series with an spst toggle switch at each bit position. Turning the switch on will load a logic 1. Placing the switch in the off position will load a logic 0. If you choose to do this, you'll need seventy switches, so be sure to shop around for a good price.

In any event, I hope you'll build a working diode PROM if you're interested in learning about the practical aspects of ROM's and PROM's. You'll learn something about *hardware* (the PROM and decoder), *software* (the truth table you plan to load into the PROM), and *firmware* (the truth table loaded in the PROM in the form of diodes). You'll also learn about *addressing* (the 4-bit character select word applied to the input of the decoder). All of these topics are fundamental to an understanding of advanced digital logic devices like microprocessors, calculators, and hobby computers. ◇

The leading magazine in the personal computer field

BYTE is the magazine for the creative home computer experimenter. BYTE tells you everything you want to know about personal computers, including how to construct and program your own system.

Home computers are now practical and affordable. Low cost peripherals have resulted in more hardware and software, more applications than you could imagine. BYTE brings it all to you. Every issue filled with stimulating, timely articles by professionals, computer scientists and serious amateurs.

Fill in the coupon today. Read your first copy of BYTE; if it's everything you expected, honor our invoice. If it isn't, just write "CANCEL" across the invoice and mail back. You won't be billed, and the copy is yours.

Allow 6 to 8 weeks for processing.

© Byte Publications, Inc. 1977

BYTE Subscription Dept. 07E
P.O. Box 361 Arlington, Mass. 02174 U.S.A.

Please enter my subscription for:

- ☐ One year U.S.-\$12 (12 issues) ☐ Two years U.S.-\$22 ☐ Three years U.S.-\$32
☐ Canada or Mexico-\$17.50 ☐ Europe (Air Delivered)-\$25
☐ Surface delivery to all other countries except Europe, Canada or Mexico-\$25
(Air delivery available on request) Please remit in U.S. funds.
☐ Check enclosed (Bonus: one extra issue) ☐ Bill me ☐ Bill Bank Americard
☐ Bill Master Charge

Card Number _____ Expiration date _____

Signature _____ Name (please print) _____

Address _____

City _____ State/Country _____ Code _____

CIRCLE NO. 7 ON FREE INFORMATION CARD



BYTE
The Small Systems Journal

BUILD YOUR OWN

BIG SCREEN COLOR TV!

THE NEW LIFESCREEN II



The SELF-CONTAINED internal projection TV that will utilize any transistor portable TV (12" to 19")... requires only 2 x 4 feet of floor space — fits neatly against any wall... and lends its beauty to the decor of any room.

- COMPONENT LIST**
 4 set of LIFESCREEN I Plans
 1 Portable transistor Color TV (12" to 19")
 1 LIFESCREEN Lens
 2 LIFESCREEN Front Surface Mirrors: one 8"x10" and one 14"x20"
 1 EXTRON LS 50 Screen, 32"x40"/50" Diag.

- ☐ PLEASE RUSH ME ONE COMPLETE SET OF LIFESCREEN I PLANS @ \$9.00
☐ PLEASE RUSH ME ONE COMPLETE SET OF LIFESCREEN II PLANS @ \$9.00

PLEASE ALSO SEND ME THE ITEMS CHECKED BELOW:

- ☐ LIFESCREEN LENS @ \$150.00
☐ LIFESCREEN FRONT SURFACE MIRROR, 8" x 10" @ \$20.00
☐ LIFESCREEN FRONT SURFACE MIRROR, 14" x 20" @ \$30.00
☐ EXTRON LS 50 Screen 32" x 40"/50" Diagonal @ \$90.00
☐ COMPLETE LIFESCREEN I PACKAGE @ \$269.00
☐ COMPLETE LIFESCREEN II PACKAGE @ \$299.00

All Prices F.O.B. factory — Cal. residents add 6% sales tax.

TOTAL: \$

EXTRON LIFESCREEN® PROJECTION SYSTEM
 8831 Sunset Boulevard,
 West Hollywood, California 90069

Name _____
 Address _____
 City _____ State _____ Zip _____
 CARD NAME _____
 CARD NUMBER _____ EXPR. DATE _____

INFO PAK — 50c

YOU ASKED FOR IT!

WE HAVE RECEIVED THOUSANDS OF INQUIRIES!

YOU REQUESTED PLANS FOR A BIG SCREEN TV THAT WOULD: utilize any portable TV as an image source — require a minimum of floor space — be a beautiful piece of furniture.

NOW — EXTRON IS HAPPY TO ANNOUNCE

THE ORIGINAL LIFESCREEN I

THE NEW LIFESCREEN II

The LIFESCREEN was designed for the Do-It-Yourself enthusiast who wishes to have the enjoyment and excitement of a professional Big Screen TV — but refuses to pay the \$1500 to \$4000 that most manufacturers charge for this luxury.

FACTS

The special LIFESCREEN₂ Lens and Front Surface mirror supplied by Extron are the same type used by major Big Screen TV manufacturers (Sony, Muntz, etc.). THESE PROFESSIONAL COMPONENTS SHOULD NOT BE CONFUSED WITH THE CHEAP PLASTIC MAGNIFYING IMITATIONS NOW FLOODING THE MARKET BECAUSE OF THE POPULARITY OF BIG SCREEN TV.

The EXTRON TV Screen — the same used by the major Big Screen TV manufacturers — is 16 TIMES BRIGHTER than a flat matte surface and 6 TIMES BRIGHTER than most flat beaded movie screens. Its parabolic shape rejects extraneous light, concentrating a highly efficient and directionally selective television image that is exceptionally sharp and colorful.

PACKAGE:

\$299
 YOU SUPPLY PARTS/LENS AND A FORMICA FINISH
 TAKES 10 TO 15 HOURS TO BUILD
 NO SPECIAL TOOLS OR ELECTRONIC SKILLS REQUIRED
 TV NOT INCLUDED

COMPLETE LIFESCREEN I PACKAGE:

\$269

THE EVERYTHING GUARANTEE

EXTRON GUARANTEES EVERYTHING: THE PROFESSIONAL QUALITY, ACCURACY OF DESCRIPTION, AVAILABILITY AND PROMPT DELIVERY OF COMPONENTS DESCRIBED IN THIS AD. If, after building your LIFESCREEN PROJECTION SYSTEM, you are not satisfied for any reason, return all components to EXTRON, 8831 Sunset Boulevard, West Hollywood, California for instant refund of the purchase price.

THE INDEPENDENT projection system that can be used with ANY SIZE screen up to 80" Diagonal — one of the many reasons for its tremendous success.

- COMPONENT LIST**
 1 set of LIFESCREEN I Plans
 1 Sharp 13" Model KV 15A21 Color TV or Sony 15" Model KV 15A1R Color TV
 1 LIFESCREEN Lens
 1 LIFESCREEN Front Surface Mirror, 8" x 10"
 1 EXTRON LS 50 Screen 32"x40"/50" Diagonal.

LARGER SCREENS can be ordered through EXTRON (67" or 80" Diag.)

Be the “New Professional” in electronics

**CREI trains you at home
for one of the most important
career levels in electronics—
plus offers you special
arrangements for engineering
degrees**

Most people think there are only two levels of careers in electronics: the technician level and that of the degree engineer.

There is, however, a third and very important level. It is that of the engineering technician or *practical* engineer. The growing importance of this career level has created what might well be called the “New Professional” in electronics.

If you look at the various levels of employment in electronics, you will understand why this “New Professional” is so important.

The average technician is a person who has had vocational training in electronics. He understands the basic principles of electronics so he can troubleshoot, repair and maintain equipment. He usually works under close supervision in performing his duties.

The engineer has college training in electronics. He usually supervises technician personnel and is responsible for planning and developing of electronic equipment and systems. Frequently, however, engineers are more heavily trained in the scientific principles of electronics and less in their practical application.

The engineering technician, by contrast, is a specialist in the practical application of electronics. His training usually consists of a two-year college program in electronic engineering technology. In many organizations, the engineering technician handles several of the responsibilities of the degree engineer. He often has the title of engineer.

CREI programs are designed to give you at home the same level and depth of training you receive in a two-year college program in electronic engineering technology. CREI programs are, in fact, more extensive than you will find in many colleges. And CREI gives you the opportunity to specialize in your choice of the major fields of electronics.

Unique Design Lab

CREI gives you both theory and practical experience in circuit design with its Electronic Design Laboratory Program. The professional equipment included in this program allows you to construct, test out and correct the circuits you design until you have an effective circuit.

This Lab Program helps you understand advanced electronics. It also gives you practical experience in many other important areas of electronics, as in pro-

Career Training at Home

totype construction, breadboarding, test and measurement procedures, circuit operation and behavior, characteristics of electronic components and how to apply integrated circuits.

Only CREI offers the unique Lab Program. It is a complete college Lab and, we believe better than you will find in most colleges. The "Lab" is one of the factors that makes CREI training interesting and effective. And the professional equipment in this program becomes yours to keep and use throughout your professional career after you complete the training.

Engineering Degree

CREI offers you special arrangements for earning credit for engineering degrees at certain colleges and universities as part of your home study training program. An important advantage in these arrangements is that you can continue your full time job while "going to college" with CREI. This also means you can apply your CREI training in your work and get practical experience to qualify for career advancement.

Wide Program Choice

CREI gives you a choice of specialization in 14 areas of electronics. You can select exactly the area of electronics best for your career field. You can specialize in such areas as computer electronics, communications engineering, microwave, CATV, television (broadcast) engineering and many other areas of modern electronics.

Free Book

In the brief space here, there isn't room to give you all of the facts about CREI college-level, home study programs in electronics. So we invite you to send for our free catalog (if you are qualified to take a CREI program). The catalog has over 80, fully illustrated pages describing your opportunities in advanced electronics and the details of CREI home study programs.

Qualifications

You may be eligible to take a CREI college-level program in electronics if you are a high school graduate (or the true equivalent) and have previous training or experience in electronics. Program arrangements are available depending upon whether you have extensive or minimum experience in electronics.

**Send for this FREE Book
describing your opportunities
and CREI college-level
programs in electronics**



Mail card or write describing qualifications to

CREI **CAPITOL
RADIO
ENGINEERING
INSTITUTE**

**McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue Northwest
Washington, D.C. 20016**

Accredited Member National Home Study Council

GI Bill

*CREI programs
are approved
for training of
veterans and
servicemen under
the G.I. Bill.*





By John McVeigh

SHORTWAVE DIRECTORY

Q. I'm an SWL'er and would like to know where I can obtain a book listing the addresses of shortwave broadcasting stations in the U.S. and foreign countries. —Todd Gerard, Scarsdale, NY.

A. One of the most complete shortwave directories I've seen is the *World Radio TV Handbook*. It is published by Gilfer Associates, Box 239, Park Ridge, NJ 07656, is updated annually, and is available for \$10.95 postpaid. The Handbook not only lists the addresses of shortwave broadcasters, but also contains data on station power, antennas, etc.

MUSICAL CALCULATOR

Q. Recently, I made an accidental discovery. When I placed my calculator near the rod antenna of my AM receiver, I found that I could produce tones by pressing the keys. Can you tell me what I was doing?—Robert Morog, Jr., Lorain, OH.

A. Inside the calculator are all kinds of switching waveforms from a clock oscillator, counters, flip-flops, etc. These waveforms (usually square waves) con-

tain many harmonics. What you heard were harmonics that were high enough in frequency to be within the AM broadcast band. If you have a programmable calculator, and some patience, you can probably write program sequences to play "melodies."

DRY TRANSFER LETTERING

Q. Where can I buy the lettering that is often used on the projects in your magazine?—Dennis Glatting, Cincinnati, OH.

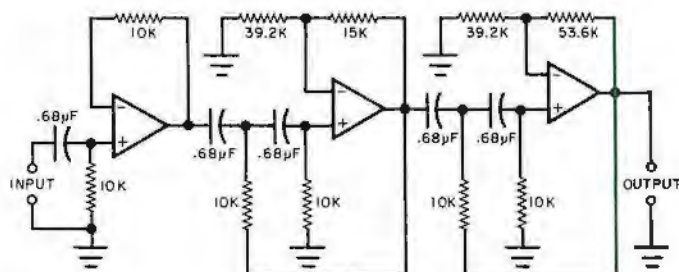
A. The lettering you refer to is called "dry transfer lettering." It is not a decal, and transfers from the sheet it is supplied on by burnishing the face of the transfer sheet with a pencil or similar object. Once it is transferred to the project panel, it should be sprayed with a lacquer fixative to prevent it from wearing off. One line of dry transfer lettering, produced by the Data Corp., 65 71st Street, Guttenburg, NJ 07093, is available at many electronics supply houses. A mail order source of dry transfer lettering (available in two sizes, and in black or white for \$3.50 a pack) is Amidon Associates, 12033 Otsego Street, North Hollywood CA 91607.

SUBSONIC FILTER

Q. I need a subsonic filter for my stereo system. I would like to insert it in the tape monitor loop or between the preamp and power amp. A very sharp cutoff below 20 or 25 Hz is required. —Joseph Hance, Richmond, IN.

A. A fifth-order, high-pass filter is shown

in the figure. It has a cutoff frequency of 25 Hz and a rolloff of 30 dB (!) per octave. I hope that's steep enough for your application. Passive components should have tight tolerances—no more than 5%. Op amps such as the 741 or LM318 are suitable. Be sure to connect the op amps to a low-ripple, regulated bipolar dc supply at about ± 9 volts.



LINE NOISE

Q. I have a serious problem with static interference on my CB radio (a mobile used with a line-powered supply). It's not there all the time, but close to it. The interference usually comes on around 6:45 AM, increasing the ambient noise level from about S2 to S8. I think the source is on the ac line, because it is on or off at regular intervals. It's not caused by any of the appliances in my house. Can you recommend a filter that I can use to block the signal?—Jeff Brown, Akron, OH.

A. First, try powering your transceiver from a 12-volt battery. If the noise is no longer present (which I doubt), it is reaching the transceiver via the ac line. This can be prevented by installing a "brute force" filter such as those manufactured by Sprague, J.W. Miller, Cornell Dubilier, etc.). If the interference persists, it is being radiated by the ac power line. There is no filter you can install between the antenna (which is picking up the noise) and the transceiver that will eliminate the noise but not the desired signal. The way to cure this problem is to sniff out the source of the radiation, which can be anything from a brush-type motor to an aquarium heater thermostat. Use the CB transceiver or a small AM radio to locate the source. A directional antenna like a small loop or ferrite loopstick can help isolate the offending appliance. If the interfering unit can be located, bypass capacitors or a line filter, (or even shielding) should be used to suppress the noise.

Sometimes, noise is generated by a component in the power line itself—a leaky insulator, intermittent contact, or loose hardware. Noise sources can be hard to locate, because the noise can travel along the line for some distance. Many power companies have interference-tracking programs, and will follow up complaints from hams, SWL's, and CB'ers. This type of interference can be continuous or intermittent, sometimes linked to the weather. Your problem suggests not a power line disorder but an electrical component drawing power from the line. However, your local power company might be able to offer more detailed information or some assistance.

Have a problem or question on circuitry, components, parts availability, etc? Send it to the Hobby Scene Editor, POPULAR ELECTRONICS, One Park Ave., New York, N.Y. 10016. Though all letters can't be answered individually, those with wide interest will be published.



Product Test Reports

REALISTIC MODEL TRC-449 MOBILE AM/SSB CB TRANSCEIVER

Company's top-of-line 40-channel mobile.



THE Realistic Model TRC-449 from Radio Shack is an AM/SSB transceiver designed for mobile communication on the Citizens Band. Its 40-channel coverage is obtained from the now-familiar phase-locked-loop (PLL) digital frequency-synthesis system. Large red LED-type seven-segment numeric indicators are used to identify the channel selected.

The Model TRC-449 features: AF GAIN, VOLUME, CLARIFIER, and SQUELCH controls; AM/USB/LSB mode selector; LED's to identify the mode selected; a switch that inserts and removes a noise blanker (NB)/automatic noise limiter (anl); bottom-facing speaker; PA/CB/MON switch; external-speaker jacks; illuminated S/r-f meter; LED DIM control; low-level clipper with filter; automatic modulation control (amc); automatic level control (alc) for SSB; electronic voltage regulation; and reverse-polarity protection and line filter. Operation is specified at 12 to 16 volts dc, negative or positive ground.

The transceiver measures 10½"W × 7¾"D × 2¾"H (26.6 × 20 × 6 cm) and weighs 6 lb (2.7 kg). Price is \$299.95.

Technical Details. The receiver section employs a single-conversion design. A transistor r-f stage is followed by a FET mixer in which the CB signal is heterodyned with the PLL's voltage-controlled oscillator (vco) and the difference

frequencies produce a 7.8-MHz i-f. AM selectivity and sideband selection are obtained with a crystal filter. Following the filter are four amplifier stages, a dual-diode AM detector, agc and meter rectifiers, and a series-gate anl. A product detector is provided for SSB operation, with carrier reinsertion obtained from a nominal 7.8-MHz beat-frequency oscillator (bfo).

Amplified agc and squelch systems are employed in the receiver. The audio section has a transistor amplifier and an IC that contains the power-output stage and provides modulation on AM transmit. The noise blanker operates at 23 MHz and gates the output of the mixer. It is switched on and off simultaneously with the audio anl.

The PLL system employs the customary 10,240-kHz crystal-controlled oscillator from which the standard 10,000-Hz reference signal is derived with the aid of digital dividers. An 11,285-MHz crystal signal is tripled and then difference-mixed with the output of the vco, after which it is divided according to the setting of the channel selector to provide a nominal 10,000-Hz signal for the vco comparison signal. Both 10,000-Hz signals are then applied to an IC phase comparator for controlling the vco.

On transmit, the output of the vco is difference-mixed at a transmitter mixer with the nominal 7.8-MHz bfo signal for generating the AM carrier for the r-f am-

plifiers. On SSB, this signal first goes to the usual balanced modulator and sideband-filter system. The output of the vco and the 7.8-MHz signal are slightly shifted to place the signal at the proper point on the required sideband for SSB or sidebands for AM.

Following the transmitter mixer are r-f amplifier, predriver, driver, and power-amplifier stages. A multisection output filter with a TVI trap minimizes harmonics and other spurious responses. It also provides matching to 50-ohm loads.

The customary collector-modulation of the driver and power-amplifier stages is engaged for AM. On SSB, all r-f stages function as linear amplifiers. Amc is provided by an agc circuit around an IC microphone preamplifier plus a low-level clipper that has a low-pass audio filter at its output to minimize distortion and other products outside the audio passband. Alc is used on SSB. Transmit/receive switching is accomplished with a relay and electronic switches.

Laboratory Measurements. The receiver's sensitivity measured 0.5 μ V for 10 dB (S + N)/N on AM at 30% modulation and with a 1000-Hz test tone. It was at least 0.2 μ V on SSB, again at 1000 Hz. Image and i-f rejection were 80 dB minimum. Other unwanted-signal and adjacent-channel rejection and desensitization were 65 dB.

The squelch threshold range was 0.3 to 1000 μ V. The agc held the audio output level to 10 dB with an r-f input change of 20 dB at 1 to 10 μ V and to 14 dB with an 80-dB input variation at 1 to 10,000 μ V. The meter indicated S9 with a nominal 100- μ V input signal and S4 with a 5- μ V input signal.

The overall 6-dB audio response was 500 to 2300 Hz on AM, 500 to 3600 Hz on LSB, and 600 to 3700 Hz on USB, peaking 3 dB at 2800 Hz. Maximum audio sine-wave output power at the onset of clipping was 3.75 watts at 2% THD with 1000 Hz into 8 ohms and 2.5% THD with 400 Hz.

Operated from a 13.8-volt dc source, the transmitter developed an AM carrier output of slightly more than 3.5 watts. Modulation at levels 16 to 26 dB greater than that required for 50% modulation, using a 1000-Hz test tone, was nominally 90% at 4.25% THD. Maximum modulation with a 400-Hz tone was about 70% at 3% THD.

Adjacent-channel splatter at more than ± 5000 Hz from the carrier was greater than 60 dB down at 1000 Hz and 50 dB down at 2500 Hz. On voice, full modulation was obtainable with splatter

well in excess of 60 dB down. The 6-dB response on AM was 475 to 2700 Hz.

The maximum SSB output power measured 10.5 watts using single-tone modulation and 12 watts PEP with voice modulation. The alc prevented overmodulation and flattopping, holding the third-order distortion products to 28 dB below two test tones or 34 dB below maximum PEP. Unwanted-sideband suppression was greater than 60 dB at 1000 Hz and was the same on receive. Carrier suppression was nominally 55 dB. The overall audio response at the 6-dB down points was 350 to 2800 and 400 to 2750 Hz on USB and LSB, respectively.

The transmitter frequency was ± 14 Hz from -15 Hz on channel 21.

User Comment. If you like lots of shiny chrome, the Model TRC-449 has it. The case is black but the front panel is chrome and simulated wood with chrome knobs. The channel selector knob has a bar grip. The other rotary controls (including the LED DIM control, which is concentric with the SQUELCH control) are small and arranged in a row along the lower half of the front panel.

The SQUELCH control extends beyond the other knobs for easy location while driving. An overhanging upper section of the front panel can obscure the control legends when the transceiver is installed well below eye level.

A miniature toggle switch is used for inserting and removing the noise blanker/anl. A similar switch gives the user a choice of CB or PA operation and includes a MON (monitor) position for disabling the internal speaker to allow signals to be monitored on a remote PA speaker.

The edgewise meter is illuminated in white on receive and in red on transmit. Its calibrating numerals are quite small and therefore difficult to read at most distances encountered in mobile installations. Also, meter indications greater than S9 tend to be somewhat compressed, making it difficult to discern the actual-signal levels in this range.

Bench tests with our impulse-noise generator indicated that the noise-atenuation system (NB/anl) permitted undisturbed readability of signals as low as 0.5 to 10 μ V in strength that were otherwise completely obliterated by the noise pulses. In our noisy test vehicle during

SSB operation, however, we noted that ignition spikes from our car with the blanker switched on were not altogether eliminated—though diminished. In any case, noise interference did not reach bothersome levels.

Switching from USB to LSB on SSB operation on the sample unit caused the transmitter frequency to drop by about 160 Hz, requiring corrective retuning at the receiving end. But this situation can be eliminated by having a licensed technician readjust the LSB crystal.

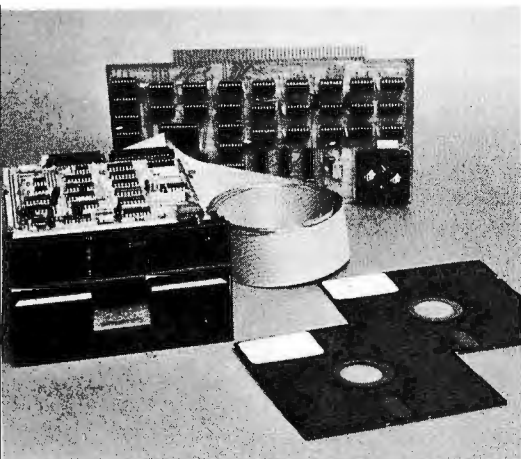
The overall performance of the transceiver was excellent, as confirmed by our laboratory measurements and on-the-air tests. It provided good receiver sensitivity, selectivity, and signal-handling capabilities. It exhibited clean, crisp audio on both receive and transmit. There was no splatter or overmodulation or discernible distortion from the low-level clipper. The unwanted-sideband suppression was fine, and the SSB distortion products were low.

In sum, the Realistic TRC-449 is a fine AM/SSB CB transceiver for its price. The SSB function will permit users to reach extra miles of communication.

CIRCLE NO. 104 ON FREE INFORMATION CARD

NORTH STAR MODEL MDS-A MICRO DISK SYSTEM

Floppy disk system provides 92k mass storage per diskette.



ALMOST every computer hobbyist dreams of owning a mass-storage facility with high access speed, such as the floppy disk systems used by the big guys. Unfortunately, the expense of a floppy disk system was prohibitively high at one time. Now, however, several flop-

py disk manufacturers have introduced a physically small drive mechanism that uses a "diskette" that measures about 5" (12.7-cm) in diameter and costs only a fraction of the full-size disk systems. These minidisks can store between 90 and 100k bytes at an attractively moderate price.

The Model MDS-A micro disk system from North Star Computers, Inc., is one such floppy. It's built around the Shugart Associates Model SA400 minifloppy TM drive mechanism. For \$699, you get the assembled and tested Shugart drive, disk system controller kit that occupies one Altair bus slot, all cables and connectors, two diskettes, and complete hardware and software documentation. One of the 5", 90-k byte diskettes contains the disk operating system (DOS) software and disk BASIC, while the other is supplied blank. The system requires 16k of resident RAM in the computer to support the DOS and BASIC.

The Model MDS-A requires 5 volts at 0.9 ampere and 12 volts at 1.6 amperes, both of which can be obtained from the host computer. Alternatively, you can

use a home-built supply or North Star's optional power supply kit (\$39.00). North Star also offers an optional case for the system for \$39.00.

General Details. The DOS board, which occupies one slot in an Altair 100-contact motherboard system, went together in a couple of evenings of relatively easy work. Once it was assembled, we used the hardware manual to test it. This manual provides complete test data, including pertinent waveforms, to ensure that the board is properly wired and works. The manual also covers system integration, interconnections, and details of the optional power supply and includes the schematic diagram of the DOS board assembly.

The software manual deals only with the DOS software. It completely explains all 16 commands used in the DOS software and uses examples to explain how to interface the DOS and BASIC software with the user's computer, whether the computer has an operating system or not.

Once the DOS and BASIC are up and running, the prerecorded diskette containing the DOS and BASIC software is removed from the drive mechanism and

replaced by the blank diskette. The DOS and BASIC and their personalized instructions are then recorded on the new diskette so that the next time the system is to be used, the computer is simply started up at the DOS entry point. Within a few seconds, the system is ready.

North Star BASIC (version 6 is provided) is very powerful. It includes multiple-dimensioned arrays, strings, multiple-lined functions, formatted outputs, and machine-language subroutine capability. Of course, it also has all the required disk functions.

In addition to all the better BASIC commands, calculator mode, etc., North Star BASIC has a REN (renumber) command that allows changing line numbers at the beginning and within a line. There is also an EDIT function that has seven editing commands to facilitate the required line changes. One very useful operation within the BASIC itself, called "compatibility," minimizes the effort required for converting programs written in other BASICs so that they can be used with North Star BASIC. For example, left bracket, right bracket, colon, and semicolon are converted into left parenthesis, right parenthesis, reverse slash, and comma, respectively. This conversion does not occur within quoted strings in a program. The conversion is automatic. Hence, you no longer have to worry about a program not running because some wrong (for North Star BASIC) symbol was typed in.

There are many other powerful commands in North Star BASIC, but space does not allow us to discuss or even enumerate them here.

User Comment. Since we put the Model MDS-A into operation, our computing has certainly been made easier. From a cold start, we can now turn on our computer, execute at E900, the DOS entry point, and have the DOS, BASIC, and any other program on the disk on our monitor screen ready to go. The whole sequence takes about 10 to 15 seconds.

We found that, with the MDS-A system, it is very easy to save BASIC and machine-language programs with only a couple of touches on the keyboard. If we sound enthusiastic about this new minifloppy system, we are. For little more than the cost of a 16-k RAM board, we have 90k of mass storage. This may not sound like much, but when you consider that it costs only \$5 more for each blank diskette, which adds 90k of storage per diskette, the cost is impressively low.

CIRCLE NO. 105 ON FREE INFORMATION CARD

Sleep on Air

For The Rest Of Your Life

KING SIZE BED \$89.95

Credit Card Orders
Call Toll Free:
800-323-2272
Ill. Res.: 312-595-0461

NEW LOW PRICES

You simply haven't known a Perfect, Restful Night until you've slept on a bed of CUSHIONED AIR. AIR is nature's most comfortable element. You are gently but firmly supported by 100% air instead of metal springs and stuffing. Many chiropractors agree that the structured Air Coil Bed has unprecedented orthopedic value as a mattress.

Lightweight...Sensual...Adjusts to your comfort. The Air Coil Bed is an experience in rest or play unmatched by any other support structure. It takes the seasickness, immobility, and weight out of waterbeds. Yet, it gives you the same "give and take" sensation. Two people can sleep on a full, queen or king size bed virtually undisturbed by the other's movements. This is because the air coil construction - with multiple controlled air chambers - supports your body evenly and independently. These permanent Beds have a beautiful velvet-like surface.

Imagine a guest bedroom you can store on a shelf, sunbathe and float on, take camping, use in your van, RV home, in your boat, summer home, on a floor or in a frame. The Air Bed comes in all standard sizes: Twin- 39"x74"x8", Double-54"x74"x8", Queen-60"x80"x8", King-74"x80"x8". You inflate it in minutes with any air pump or canister vacuum cleaner (adapter included). Made of durable 20 gauge poly vinyl, the beds include a 1 year manufacturer's warranty. Also available: Special High Powered Air Pumps enable you to inflate your beds in minutes. The AC pump operates from any standard household electrical outlet. The DC pump operates from your auto or van cigarette lighter. Air pumps are \$29.95 each.

Contemporary Marketing Inc. 790 Maple Lane Bensenville, Ill. 60106

Send Coupon To



Please send me the following AIR COIL BEDS. If not satisfied, I can return within 10 days for a prompt refund.

- | | |
|---|-----------------|
| <input type="checkbox"/> King \$89.95 | (Item No. 1374) |
| <input type="checkbox"/> Queen \$69.95 | (Item No. 1360) |
| <input type="checkbox"/> Full \$59.95 | (Item No. 1354) |
| <input type="checkbox"/> Twin \$44.95 | (Item No. 1339) |
| <input type="checkbox"/> JAC Air Pump \$29.95 | (Item No. 0004) |
| <input type="checkbox"/> JDC Air Pump \$29.95 | (Item No. 0005) |

☐ Check or M.O. enclosed
☐ Charge my Credit Card:

☐ B. of A. (Visa) ☐ Diners Club ☐ Carte
☐ Master Charge ☐ Amer. Exp. ☐ Blanche

Credit Card No. _____ Exp. Date _____

Name _____

Address _____

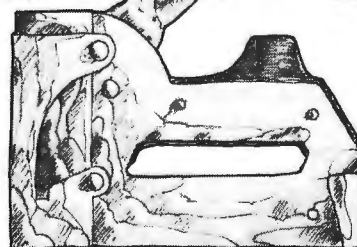
City _____ State _____ Zip _____

Signature _____ PEMA-305

©CMI 1977

CIRCLE NO. 12 ON FREE INFORMATION CARD

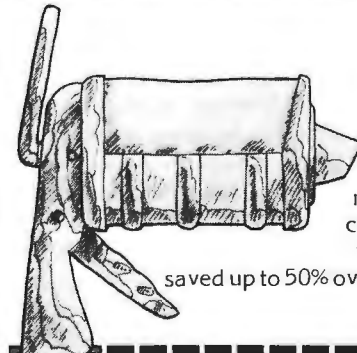
KIT TOOLS



1. Build a high-quality, multi-element stereo system with this staple gun. No fooling. We do all the hard parts, leaving you with fully-illustrated instructions on things like stretching the grill cloth. No cabinetry. No soldering. Think you can handle it?



STAPLE.



2. With this tube of silicone goo, you mount the speaker elements. The kind of speakers you couldn't afford otherwise: horn drivers, woofers with butyl surrounds and high-temperature voice coils - we build them in our own factory. When you get through, you've saved up to 50% over the cost of ready-made speakers.



GOO.

I may be able to handle it.
Send me your 48-page free catalog-manual.

Speakerlab
Dept. PE-D, 5500 35th NE,
Seattle, Washington 98105

Name _____ PE-D
Address _____
City _____ State _____ Zip _____



Computer Bits

By Hal Chamberlin

HIGH-LEVEL LANGUAGES

DURING the short 30-year history of computers in general and even shorter 4-year history of microcomputers, the most significant software development has been the availability and use of high-level computer languages. The term "high level" is used because these languages allow a programmer to interact with the machine on a less detailed and more meaningful basis than does a so-called "low-level" machine language. The high-level languages permit the average person to use a computer system effectively without having to acquire a large amount of specialized knowledge about binary number systems, memory mapping, character codes, and other such nonsense. Also a given high-level language tends to be the same regardless of the particular type of computer involved. This, of course, is not true with machine or assembly language, which is entirely different when going from one computer type to another.

High-level languages can be broken down into two basic groups. The first group consists of *general-purpose* programming languages. These are intended for use in writing computer programs, both casual and professional. They are called general purpose because they can be used, at least in theory, to write any kind of computer program. Some specialization does exist however. For example, FORTRAN is best suited for complex scientific calculation but has been used for business data processing. COBOL is the most widely used language for business programming but it also has scientific applications although it is very inefficient in that field.

Members of the second group are called "application languages". These are associated with particular "application package" programs. One example is ECAP which stands for Electronic Circuit Analysis Program which is used to simulate and analyze the behavior of electronic circuits. The ECAP language is used to describe the circuit of interest and to instruct the program on what to do with the circuit just described. Another

is COGO standing for Civil Engineering Coordinate Geometry, which is used to aid surveyors in evaluating and mapping parcels of land. Using an application program and associated language for its intended purpose is vastly simpler than writing a program to do the same thing from scratch with a general-purpose language.

Of course, all of these advantages of high-level computer languages do not come free. A given program written in a high-level language invariably requires more computer memory and more execution time. The differences generally are not trivial either. On a large machine the difference in memory requirements can easily be 3 to 1 and execution time 5 to 1. On a microprocessor, the memory difference might actually be smaller but the time difference can be 10 to 1 to over 100 to 1.

The difference in programming effort swings to the other extreme with high-level languages requiring as little as one-tenth the effort from inexperienced programmers. Professional programmers cope better with machine-level languages but the difference is still substantial. In effect, machine language gives the programmer complete control over the details of programming thus providing the opportunity to write an *efficient* program, one that takes a minimum of memory and execution time. The situation is analogous to automatic versus manual transmissions in cars. Better gas mileage, quicker acceleration, and better handling in snow is possible with a 4-speed manual transmission but the automatic is more convenient and easier to learn.

Most hobbyists want to run BASIC on their systems and are willing to pay a premium in order to do so. BASIC is a well-known, very easy to learn, general-purpose computer language that works well on small systems. It is particularly effective for small- to medium-sized programs involving mathematics and character string manipulation.

Several other languages are now slowly being implemented on microcom-

puters. Probably the most widely desired is FORTRAN which is better suited than BASIC for writing large or complex programs. Accordingly, larger systems with more main memory and mass storage devices are required to run FORTRAN. Many application packages such as ECAP mentioned earlier are written in FORTRAN. Actually BASIC was modelled after FORTRAN with many of its difficult or confusing features omitted or modified.

Another language generating much interest among advanced hobbyists is APL. This is a highly symbolic language that is very adept at handling arrays of numbers and other structured data.

Inside High-Level Languages. Actually a high-level language package is nothing more than a program itself, although it is very complex. Simply stated, the "language processor program" looks at statements in the particular high-level language and translates them into equivalent machine-language operations. Such language processor programs are called "compilers" and "interpreters" according to the two distinctly different methods of translation. Incidentally, most language processors are written in machine language to maximize efficiency of the translation process which, as will be shown later, is very important.

When using the compiler type of translator program, it is really a two-step process to take a program written in the high-level language and get it running on the computer. First the compiler program takes the high-level language statements, which as a group are called the *source program*, and translates them, one at a time, into equivalent machine-language instructions. The collection of generated machine-language instructions is sent to a storage device (such as a cassette or floppy disk) and is called the *object program*. Now we have an equivalent program in machine language written on the storage device which completes step one.

Before the object program can be run, it must be loaded into memory. Along with it are loaded some utility subroutines which are called the *run-time package*. These subroutines perform generally needed functions such as binary/decimal conversion, mathematical functions, and others. Usually a special loader program is required to read the object program and run-time package into memory and get them properly linked together. After the loading process is complete, the program may actually be run just as though it had been written in

machine language in the first place.

Using the interpreter type of translator is generally much simpler. The main idea is to make the programmer believe that the computer is actually executing the high-level language directly. Accordingly a portion of the interpreter is actually a text editor which aids the programmer in entering the high-level language program into memory and changing it. The source program in this case is stored in memory as ASCII character strings which is simply the original program text or a slightly modified version of it. After the program is typed in, it may be run directly by using the second portion of the interpreter.

In effect the interpreter looks at the first program statement, translates it to machine language, executes it, and then forgets the translated version. Then the second statement is processed in the same manner. If a group of statements constitutes a loop, each is translated, executed, and thrown away in turn, even though these statements may have been translated hundreds of times previously. Actually most interpreters do not generate real machine language and then execute it. Instead, they scan the high-level language statement, extract the important information from it and act directly on the basis of that information. Thus the impression is given of a machine with a very powerful instruction set that actually executes the high-level language directly.

Now what about the relative merits of the two techniques? The interpreter certainly sounds simpler and more convenient to use and indeed it is. But what is gained in ease of use is lost in execution speed. Most programs spend nearly all of their time in one or more short loops. With an interpreter, the statements of the loop are repeatedly scanned and translated. Usually the translation process for a statement takes longer than the actual work specified by the statement. With a compiler, all of the statements of the program are translated once so that, during execution, only the time necessary to perform the useful work is needed. Storage space for the user program is not significantly different between a compiler and an interpreter. However, since the compiler program is not in memory when the object program is executing, it is likely that a larger program could be accommodated with a compiler.

The choice between interpreter and compiler depends heavily on the language. BASIC is nearly always implemented as an interpreter in order to

maximize its convenience. FORTRAN, on the other hand, is usually compiled. APL, due to its very structure, is always interpreted. Actually, since APL programs are so compact, the overhead associated with interpretation is much less than with a verbose language such as BASIC.

Hardware Required. Using BASIC as an example, how large must a system be to use it effectively? Usually the only input/output device required is a terminal of some sort. A mass storage device is handy for saving programs but is not necessary to run them. Thus the important measure of system size is simply the amount of memory present. Accordingly, BASIC interpreters are usually rated by the amount of memory required by the interpreter and the number of language "features" supported. Memory requirement figures often include a small area for storage of the user program but this generally amounts to only a few lines of BASIC.

The smallest BASIC interpreters can be as small as 2k bytes. Being so small, they offer only the most important language features and are often given the name *Tiny BASIC*. The most distinguishing feature of a *Tiny BASIC* system is that only integer numbers are allowed, usually constrained to values between -32,768 and +32,767. So-called "full-featured" BASIC interpreters can run in as little as 4k. These support normal floating point (scientific notation) arithmetic and common mathematical functions but lack the features for character string manipulation. The most common interpreter size is 8k. All useful mathematical functions are allowed, two dimensional arrays are permitted, and statements are provided for handling character strings. The ultimate is variously called Disk BASIC, 12K BASIC, Extended BASIC, and other similar

names. In addition to all of the features just mentioned, these interpreters allow user programs to set up and access files of data on a floppy disk or cassette tape. If any kind of home accounting or small business applications are expected to be written in BASIC, then this is the version that is needed.

As noted above, additional memory is required for all but the most trivial programs. Although it is difficult to judge how much memory a given program will require without actually trying it, a good rule of thumb is to allow 1k per 50-line page of sparsely commented BASIC statements. If long statements with a lot of comments are more your style, 2k per page might be a better figure. Also, many interpreters allow the mathematical functions to be deleted if not needed thus freeing 500 to 1000 more bytes of memory.

Speed is even harder to pin down than memory requirements; but compared to machine language, BASIC is quite slow. Simple arithmetic operations such as addition and subtraction generally take about 5 milliseconds each while multiply and divide take a little longer. Of course the floating point arithmetic, which itself is a complicated subroutine in the interpreter, is partially responsible but tests have shown that even integer-only *Tiny BASIC's* are not much faster. Thus the conclusion is that the interpretation process takes a lot of time. In many cases of course, speed is of no consequence, but if a lot of calculation is to be done the time can add up quickly. An excellent article in the June, 1977 issue of *Kilobaud* magazine compares the speed capabilities of several BASIC interpreters.

Increased use of high-level languages is definitely a wave of the future which will be spurred on by the development of microprocessors specifically designed to support such languages. ◇



MAGAZINE CASES

Designed Exclusively for

POPULAR ELECTRONICS

● The ideal way to save your valuable copies, keep them well protected and make it easy for you to refer to any issue at any time. Both decorative and attractive enough to enhance the decor of any room, each case holds a full year's copies. Constructed of reinforced fiberboard, these durable cases are covered in a rich-textured leatherette. The gold embossed back adds to its elegance and makes each case a welcome addition to your bookshelf or cabinet.

Cases are available for your favorite magazines

Only \$5.95 each, 3 for \$15.50 in any combination of titles, including all postage and handling charges. Outside U.S.A. add \$1 per case.

CHARGE YOUR ORDER TO YOUR AMERICAN EXPRESS, BANKAMERICARD, MASTER CHARGE OR DINERS CLUB ACCOUNT.

Ziff-Davis Serv. Div., Dept. JJ, 595 B'way, N.Y. 10012
Please send the Magazine Cases indicated below:
PE-65 TITLE QUANTITY

CHECK: ☐ All Black ☐ Maroon Back, Black Sides
☐ ENCLOSED IS \$_____ PE-117
☐ CHARGE: ☐ BankAmericard ☐ Master Charge
☐ American Express ☐ Diners Club

Account # _____ Exp. Date _____
Master Charge Interbank # _____
(4 numbers over your name)

Signature _____
Print Name _____
Address _____
City _____ State _____ Zip _____
Residents of Calif., Col., Fla., Ill., Mich., Mo., N.Y. State, D.C. and Tex. add applicable sales tax.



CB Scene

By Walter Salm

THE FORGOTTEN CB SERVICE

IF YOU'VE been involved with personal communications for a while, or are a student of radio history, you know that the 11-meter band does not house the only CB service. The popular and overcrowded CB radio in use since 1958 is called "Class D" because it was actually the *fourth* CB radio service authorized by the FCC. First there was Class A in 1947, followed by the now-defunct Class B. Class C is allocated for model radio control use and is still operational. So is Class A, the "forgotten" CB service which, at last count, had about 5000 licensees nationwide. The tally for Class D, on the other hand is approaching 12 million.

Why is Class A so underpopulated? For one thing, equipment has been much more expensive; so people who are geared to thinking of CB in terms of \$150 for a transceiver may not want to plunk down \$400 or more for a Class A radio. What do you get for that \$400?

(1) You can have a transmitter power output up to 50 watts (though it may be limited to 15 watts in some areas).

(2) There will be only one or two channels on the radio. If you want to switch to other channels, you'll need a new pair of crystals and a new frequency authorization from the FCC. This is because you request specific frequen-

cies when you make an application for a license. All that good-buddy type of CB'ing goes out the window. If you buy Class A, you're buying it to communicate with specific parties.

(3) Class A is FM, so it has inherent freedom from noise interference.

(4) It's also uhf, using the 460-to-470-MHz part of the spectrum, and this makes it strictly line-of-sight. But line-of-sight isn't all that bad when you consider the overcrowding, sunspot skip and higher noise levels of today's AM Class D CB.

How much usable distance can you get mobile-to-mobile on AM CB today? Three miles? Maybe four? When you get stepped on by some joker running an illegal linear, forget about talking entirely.

On uhf, you get clear, reliable communications for a distance of about 20 miles mobile-to-base if there are no obstructions. With a repeater, you can reach 60 miles or more, and community repeaters are going to become popular for this service very soon.

Equipment. One company, Standard Communications, is doing something about the sad state of Class A. Until this year, if you wanted Class A, you had to buy uhf equipment that was designed for business radio use and plug in crystals for Class A. Standard introduced a unit last spring designed specifically for Class A service and priced at \$399. Sure, that's 10 times the price of a Class D rig, but look at the advantages you're getting. If you want to communicate with your home or office, you can really do it with clear, noise- and interference-free channels.

Standard says that its distributors are selling Class A radio briskly now, and there's a great interest in repeaters as well. Chances are that community repeaters will be set up the way they are now for business users. The dealer who

sells you the equipment also owns a repeater and will rent you air time on the station for a monthly fee. Business radio users typically pay \$25 to \$30 a month for this. There's no reason why CB clubs can't get involved in Class A and set up their own repeaters. This would work out to be a real bargain for the CB'er who goes into Class A, and would certainly stimulate interest in the service.

Class A has been so neglected, in fact, that it has been losing channels to business radio services. Today's Class A has just 16 channels (often referred to as "eight pairs" because duplex operation is common), but at one time, there were many more channels assigned to Class A—as many as 75. When nobody is using a service, it seems fairly easy for the FCC to say, "Let's take a few channels from that service and give them to another." That's exactly what happened.

Here's what is left for the Class A user, organized by the FCC into properly spaced pairs for the duplex user:

Base and Mobile	Mobile Only
(MHz)	(MHz)
462.550	467.550
462.575	467.575
462.600	467.600
462.625	467.625
462.650	467.650
462.675	467.675
462.700	467.700
462.725	467.725

Notice that the "matched pairs" have 5-MHz spacing between them, making duplex operation possible. It also provides more than enough channel isolation for repeater use.

Licensing. If you're afraid to approach Class A because of licensing, bear in mind that it's still CB, and you don't need any more qualifications for a license than you do for Class D. The application form is different and slightly more complicated, and there's no temporary operating permit.

Also, it's unlikely that your favorite CB store will have the equipment on hand. The dealer will have to order it for you, and this could take from a few days to a few weeks, depending on whether he can get the transceivers from a nearby distributor. Another possible delay can develop when you want crystals. As things stand now, Class A crystals are not items that even the most complete CB shop is likely to stock. Again, a special order will probably be required.

There's a different license form to fill



"Breaker, Watson, do you copy?
This here's rubberduck. Over."

out for Class A—Form 400. Also, you have to get something called a construction permit from the FCC. This is combined with the Form 400 and all it really requires is that you tell the FCC how high an antenna you plan to erect for your base station (200 ft max), give the exact location, and certify that it's not near enough to any airports that it would be under FAA restrictions.

If the proposed installation does come under FAA restrictions, it's a whole different ballgame, with formulas to determine how high the antenna can be, etc.

The Future. There's little danger of channel crowding on FM CB, at least for now; it's that under utilized. Also a lot more power is permitted—legally—than on Class D. A typical Class A transceiver has an r-f output of 25 watts, and most installations can legally go as high as 50 watts.

But high power levels aren't really needed here. Line-of-sight operation means that relatively modest transmitter power will be adequate. Because there's no possibility of working skip, no advantage is gained by using illegal, high-powered amplifiers. On the other side of the coin, there is hardly any possibility of getting skip interference.

Back in 1947, when Class-A CB was first legalized by the FCC, the uhf spectrum was still a no man's land. Little was known or understood about it, and many people believed that it would be totally unusable for everyday communications. In later years, when Class-DCB was legalized, it was plopped right in the middle of the "noise band"—a group of frequencies prone to man-made radio interference (from industrial electrical equipment and radio diathermy machines in particular).

More recently, uhf business-band us-

ers have proven that this once-useless radio band is very usable, but the government has taken away much of what was given in 1947.


Will the remaining 16 channels be grabbed up for business radio? Probably not, because there's so much renewed interest in these frequencies. Besides, there are 5000 licensees currently using it, and they have made fairly sizable investments in equipment. But to preserve these few channels, we'll have to see more people using them. They're there, just waiting for us. ◇

DAVIS
ELECTRONICS

NEW!

Mini Counter

60 MHz
600 MHz
(with optional prescaler)



Gate Input

Range: 60 MHz, 600 MHz

Mode: TMC, OFF

Power: ON, OFF

General Purpose Low Cost Counter Without the Sacrifice of Basic Performance

"Check the features we have that some other low cost counters don't have."

- All Metal Cabinet
- 8 Digit 4" LED Display
- Input Cable Included
- 12V Input Jack
- Push Button Controls
- Gate Light

- Completely Auto Decimal Point
- Selectable Gate Times (1 sec & .1 sec)
- State of the Art LSI Circuitry
- Sensitivity <10 MV
- Crystal Time Base
- 115V or 12V Operation

7208 60 MHz Assembled	\$169.95
7208A 600 MHz Assembled	\$199.95

ORDER NOW
Call Toll Free
1-800-828-7422

DAVIS ELECTRONICS 636 Sheridan Dr., Tona., N.Y. 14150 716/874-5848

CIRCLE NO 15 ON FREE INFORMATION CARD

If You're Into Automotive Investment, Here's a Statement About Profit and Loss: Buy The Mark Ten B Electronic Ignition And Sonic Sentry Anti-Theft Alarm Now!



The profitable part about the Mark Ten B capacitive discharge system is that it actually eliminates 3 out of 4 tune-ups and deals with rough idling, slow starting, hesitation during acceleration and poor gas mileage—on the spot! To prevent loss, the **Sonic Sentry** protects your vehicle and contents from theft by literally blowing the horn on anyone who intrudes into the harmless, ultrasonic field it emits throughout the interior of your car, truck, van, camper, bus, boat or airplane. To learn more about these quality, protective accessories from Delta, invest a minute of your time by filling out and mailing the attached coupon today!

DELTA PRODUCTS, INC.

One Delta Way, Dept. PE
Grand Junction, Colorado 81501/(303) 242-9000

Please send complete information about the Mark Ten B and the Sonic Sentry, together with facts on Delta's full line of dynamite automotive, recreational vehicle, and security products to:

Name

Street Address

City State Zip

CLIPPER CIRCUIT QUIZ

BY ROBERT P. BALIN

A SIMPLE circuit consisting of a diode, resistor, and battery can be used as a clipper or limiter, or to shift the zero reference level of a waveform. Just what a particular arrangement will do is predictable if you observe the polarity of the net circuit voltage,

diode biasing, and each voltage drop.

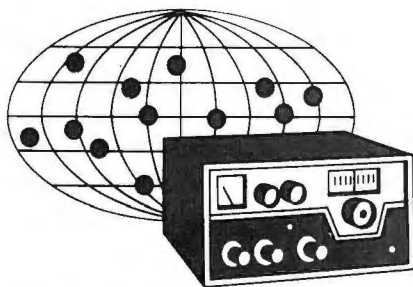
See if you can match the output waveforms (A-J) with the circuits (1-10) below. In each case, the input is a sine wave with a peak voltage twice the cell's voltage. The resistor is large compared to the forward resistance

of the diode yet small compared to its reverse resistance. The dotted lines represent the undistorted output waveform.

Hint: Assume a cell voltage of three volts and see what happens as the input sine wave goes to +6 and -6 volts in 1-volt steps.

<p>1. _____</p>	<p>2. _____</p>	<p>A</p>	<p>B</p>
<p>3. _____</p>	<p>4. _____</p>	<p>C</p>	<p>D</p>
<p>5. _____</p>	<p>6. _____</p>	<p>E</p>	<p>F</p>
<p>7. _____</p>	<p>8. _____</p>	<p>G</p>	<p>H</p>
<p>9. _____</p>	<p>10. _____</p>	<p>I</p>	<p>J</p>

Answers: 1-H, 3-C, 5-I, 7-A, 9-G, 2-F, 4-J, 6-D, 8-E, 10-B



DX Listening

By Glenn Hauser

SHORTWAVE PROGRAMS

IT'S EASY for DX listeners to fall into the trap of getting so involved in the process of tuning in distant countries, that we lose sight of the purpose of the broadcasts in the first place—*programs* to be listened to for their content. Here is a selection of several different types of programs. To avoid confusion, all times and days are in GMT, which means that most programs after 0000 are heard in North America on the *previous* day. (And no doubt some stations will make schedule changes after we go to press.)

Mailbags. These are replies to listener letters on the air. Most try to answer questions about the country. Some give the full address of writers. The *BBC* program is about *BBC* programs only.

BBC Letterbox—Sat. 2315, Sun. 0515, 2015. Lots of cute, clever touches.

Moscow Mailbag—Sat. 2315, Sun. 0115, 0315, 0445, 0645; repeated 24 hours later. Joe Adamov achieves more credibility than on any other *Moscow* program.

R. Sweden Mailbag—on all Sunday broadcasts.

R. Nederland Letterbox—about one hour after the start of alternate Thursday broadcasts. But after November it will disappear or move to another day.

R. Australia Mailbag—Sun. 0140, 0740, 1240, 1940. Probably the most popular of all, emphasizing international friendship. Host Keith Glover provides lots of personal touches.

VOA Letters from Listeners—Sat. 1115, 1915, Sun. 0015. It's interesting to see how our official Voice fields questions from listeners; has a really catchy theme. Americans are forbidden to participate.

IBA Calling All Listeners—Sun. 2015, 2245. Hosts don't hesitate to disagree with writers hostile to Israel.

WINB Mail Call—Sun. 2230. The station's *only* locally produced, live program. It proves people really do listen to this rather dull evangelistic and music-fill station, if only to get a QSL. This may move to 1845 in November.

Belgium—toward the end of Wed. and Fri. program, *BRT4* schedules a Mailbag. You may have better luck getting the transcript they mail out.

RCI replies to letters irregularly on the Sunday edition of *Weekend Magazine*.

Science and Technology. All these programs try not to get too technical.

CBC Northern Service Quirks and Quarks. An excellent popular science series, hosted from Vancouver by Dr. David Suzuki. Each week, Isaac Asimov is one of the guests, explaining a science word. Sat. at 1710-1800 (an hour earlier by GMT when on daylight time). Also on the *CBC* AM network.

BBC World Service has several programs with different approaches and emphases: *Discovery*, Tue. 1030, Wed. 1715, Thu. 0030. *New Ideas*, Sun. 0445, 2315. *Science in Action*, Fri. 1030, 1615, Mon. 2115. *Nature Notebook*, Wed. 0430, Fri. 2145. *Farming World*, Wed. 1130. Some of these take a break during part of the year, but always come back, often at new times.

SBC, Switzerland, had an *Agricultural Index* program on the first Sunday of each month earlier this year, but may replace it in November.

R. Moscow Science and Engineering, Thu. 2315, Fri. 0115, 0315, 0445, 0645.

VOA New Products, USA, Sun. 1307, 1707, 2107, Mon. 0107; *New Horizons*, Sun. 1115, 1915, Mon. 0115.

Drama and readings. A rare commodity, but not as rare as on domestic radio!

BBC World Service is way out in front, with one or two dramatic serials running at changeable times, and two regular drama blocks: *Theatre of the Air* (the only *BBC* program which may last as long as 90 minutes), Sun. 0030, 1130; and *Radio Theatre*, 45 minutes, Fri. 0030. *World Service Short Story*—readings of original stories submitted by listeners—Mon. 0145.

CBC Northern Service has blocks reserved for drama Mon-Fri at 1903 (sum-

mers 1803). Also, the newsmagazine *As It Happens* regularly includes comedy or drama during its final half hour (0030 in winter, 2330 in summer). During busy periods it's on Fridays only; in December and summer it's every weeknight; heavy on old-time radio.

VOA Critics Choice, an arts magazine, often features dramatic readings: Sun. 1313, 1713, 2113; Mon. 0013.

Classical Music. Many stations feel shortwave isn't a suitable medium; few can spare the time to play full works. But some include at least a token amount. It's nice to have when you can't find any on domestic radio—and some of these stations have strong, clear signals.

VOA Concert Hall, Sundays at 1215-1300, 2015-2100. Other days, Willis Conover's first-rate jazz show.

CBC Northern Service Gilmour's Albums, Sun. 1705-1800 (summers 1605). Mainly vocal music, with lots of opinion by music critic Clyde Gilmour from Toronto.

HCJB En la Sala de Conciertos, only in their Spanish service—but the music is what counts. Mon.-Fri. 1830-1900; Sat. and Sun. 1800-1900. Check in the 19m band.

R. Nederland, with only half an hour, this cultural magazine, *The Monday Programme*, may still work in some short pieces.

BBC World Service broadcasts *Promenade Concerts* live at 1830 during the summer, but not in winter, and not to North America. There are a number of 15-to-30 minute music or musical commentary programs running at any given time in a variety of slots. Dependable times for longer works are Sun. 1515-1600, Mon. 0100-0145, and Fri. 0630-0700.

RAI. A traditional come-on for SW radio buyers is "hear opera direct from Italy!" Well, you won't find any on *RAI*'s 20-minute English programs, and only excerpts on the Italian programs, Wed. and Thu. 2325-2350, Sat. 0025-0035, Sun. 0005-0025 and 2255-2325. Check 9575 kHz.

Radiodifusora Nacional de Colombia has large blocks of classical concerts all day long. The drawbacks: off-frequency from 15,335 kHz, single sideband, and distorted audio.

Musical Requests. This is another popular way for listeners to participate.

BBC World Service The Pleasure's Yours, exclusively classical, recently expanded to 45 minutes, Tues. 2030. The rest in this listing are pop and rock. Bob
(Continued on page 119)

ENGLISH LANGUAGE SHORTWAVE BROADCASTS FOR NOVEMBER 1977 THROUGH FEBRUARY 1978

BY RICHARD E. WOOD

TIME-EST	TIME-GMT	STATION	QUAL *	FREQUENCIES, MHz
6:00-6:25 a.m.	1100-1125	Tirana, Albania	F	9.50, 11.985
6:00-7:25 a.m.	1100-1225	Trans-World Radio Bonaire, N.A.	G	11.815
6:00-8:00 a.m.	1100-1300	Melbourne, Australia	G	9.58
		London, England	G	5.99 (via Sackville)
6:00-9:00 a.m.	1100-1400	**VOA, Washington, USA	G	5.955, 9.73
6:28-9:00 a.m.	1128-1400	**Montreal, Canada (Northern Service)	G	6.065, 9.625 (includes French, etc.)
7:00-7:30 a.m.	1200-1230	Jerusalem, Israel	G	11.655, 12.025, 15.10, 15.485
7:00-7:55 a.m.	1200-1255	Peking, China	F	11.688
7:10-7:30 a.m.	1210-1230	**Santiago, Chile	F	9.566, 11.81, 15.15
7:15-7:30 a.m.	1215-1230	Athens, Greece	F	15.345, 17.83
		HCJB, Quito, Ecuador	G	11.745
7:30-8:00 a.m.	1230-1300	Stockholm, Sweden	F	15.305
7:30-8:20 a.m.	1230-1320	Trans-World Radio, Bonaire, N.A.	G	15.255 (Sat., to 1420 Sun.)
7:30-11:30 a.m.	1230-1630	HCJB, Quito, Ecuador	G	11.745, 15.115
8:00-8:30 a.m.	1300-1330	London, England	G	5.99 (via Sackville), 6.195 (via Antigua), 11.775 (via Antigua; Sat., Sun. from 1200)
		**Bucharest, Romania	G	11.94, 15.25
8:15-8:45 a.m.	1315-1345	Berne, Switzerland	G	15.14
8:30 a.m.-3:00 p.m.	1330-2000	**London, England	G	9.41, 15.07
8:30-9:00 a.m.	1330-1400	Helsinki, Finland	G	11.755, 15.105
9:00-9:30 a.m.	1400-1430	Stockholm, Sweden	G	15.305
9:00 a.m.-7:00 p.m.	1400-2400	**Montreal, Canada (Northern Service)	G	9.625, 11.72 (includes French, etc.)
9:30-10:00 a.m.	1430-1500	Helsinki, Finland	G	11.755, 15.105
10:00-11:00 a.m.	1500-1600	London, England	G	17.84 (via Ascension), 9.58 (via Sackville Sat., Sun.)
10:15-10:30 a.m.	1515-1530	Athens, Greece	F	11.73, 15.345, 17.83 (last 2 freq. not on Tues.)
11:00-11:15 a.m.	1600-1615	London, England	G	9.58 (via Sackville)
11:00-11:30 a.m.	1600-1630	Oslo, Norway	G	17.84 (via Ascension)
11:15 a.m.-12:09 p.m.	1615-1709	London, England	G	15.175 (Sun.)
11:42-11:50 a.m.	1642-1650	Hilversum, Holland	G	9.58 (via Sackville; Sat., Sun.-1745)
11:45 a.m.-12 noon	1645-1700	**Montreal, Canada	F	15.19, 17.775, (Mon.-Fri., via Bonaire)
12 noon-3:00 p.m.	1700-2000	**Kuwait, Kuwait	G	15.325, 17.82
12:04-12:56 p.m.	1704-1756	**Paris, France	G	9.58, 12.085
1:00-1:30 p.m.	1800-1830	**Montreal, Canada	G	9.52, 9.63, 11.705, 11.73, 11.735, 11.745, 11.89, 11.905, 11.93, 15.30, 15.425, 17.72
1:45-3:00 p.m.	1845-2000	**Abidjan, Ivory Coast	G	11.865, 15.325, 17.82
2:00-5:00 p.m.	1900-2200	**Jeddah, Saudi Arabia	F	11.92 (irreg.)
2:30-3:00 p.m.	1930-2000	**Montreal, Canada	G	11.855
		**Baghdad, Iraq	F	11.855, 15.325
3:00-3:30 p.m.	2000-2030	Jerusalem, Israel	G	9.745
		**Tehran, Iran	F	5.90, 7.4125, 9.022
3:00-4:00 p.m.	2000-2100	Accra, Ghana	P	11.85
3:00-4:15 p.m.	2000-2115	London, England	G	15.26 (via Ascension)
3:50-4:50 p.m.	2050-2150	**Havana, Cuba	G	11.865, 17.75
4:00-4:30 p.m.	2100-2130	**Berne, Switzerland	G	6.165, 9.535, 9.59
4:00-4:50 p.m.	2100-2150	**Johannesburg, S. Africa	G	7.27, 9.585, 11.80, 11.90
4:15-5:00 p.m.	2115-2200	London, England	G	5.975, 15.26 (via Ascension)
4:30-5:00 p.m.	2130-2200	**Sofia, Bulgaria	G	6.07, 9.70
4:40-5:20 p.m.	2130-2220	Hilversum, Holland	G	9.715, 11.73 (Sun.; Dutch; time tentative)
5:00-5:15 p.m.	2200-2215	**Belgrade, Yugoslavia	F	6.10, 7.24, 9.62
5:00-5:30 p.m.	2200-2230	Tokyo, Japan	F	15.105
5:00-5:45 p.m.	2200-2245	London, England	G	5.975, 6.175 (via Sackville), 6.195 (via Antigua)
5:00-6:15 p.m.	2200-2315	**Cairo, Egypt	G	9.51 (via Sackville), 15.26 (via Ascension)
5:00-7:30 p.m.	2200-0030	Ankara, Turkey	G	9.805
5:30-6:00 p.m.	2230-2300	Jerusalem, Israel	G	9.515, 11.88
		Vilnius, U.S.S.R.	G	5.90, 7.4125, 9.435, 9.815
			G	5.915, 5.94, 7.31, 7.355 7.44 (Sat., Sun.)
5:30-6:20 p.m.	2230-2320	Johannesburg, S. Africa	G	5.98, 9.585, 11.80, 11.90
5:45-6:00 p.m.	2245-2300	London, England	G	5.975, 6.175, (via Sackville), 7.32, 9.51 (via Sackville), 15.26 (via Ascension)
5:50-6:10 p.m.	2250-2310	**Santiago, Chile	F	9.566, 11.81, 15.15
6:00-6:30 p.m.	2300-2330	Stockholm, Sweden	F	6.045, 6.12, 9.695
		London, England	G	5.975, 6.175 (via Sackville), 7.32, 9.51 (via Sackville), 9.58 (via Ascension), 15.26 (via Ascension)

		Moscow, U.S.S.R.	G	5.94, 6.02, 6.125, 7.205, 7.235, 7.355, 7.44, 9.635, 9.79, 9.80, 12.05, 15.14, 15.18, 15.45, 17.72
		Tokyo, Japan	F	15.105
6:00-6:50 p.m.	2300-2350	**Buenos Aires, Argentina	G	11.71 (Mon.-Fri.)
6:00-8:00 p.m.	2300-0100	Montreal, Canada	G	6.04 (alternate 5.96; Mon.-Fri.)
6:30-7:00 p.m.	2330-2400	Moscow, U.S.S.R.	G	4.86, 5.94, 6.02, 6.125, 7.105, 7.115, 7.16, 7.205, 7.235, 9.635, 9.79, 9.80, 12.05, 15.14, 15.18, 15.45, 17.72
6:45-7:30 p.m.	2345-0030	London, England	G	5.975, 6.175 (via Sackville), 7.32, 9.51 (via Sackville), 9.58, 15.26 (both via Ascension)
6:45-7:45 p.m.	2345-0045	Tokyo, Japan	P	9.525, 11.705
7:00-7:25 p.m.	0000-0025	Tirana, Albania	G	7.065, 9.75
7:00-7:30 p.m.	0000-0030	Oslo, Norway	F	6.18, 9.55, 9.645 (Sun.)
		Tokyo, Japan	F	15.105
		Moscow, U.S.S.R.	G	4.86, 5.94, 6.125, 7.105, 7.15, 7.185, 7.205, 7.355, 7.44, 9.80, 12.05, 15.14, 15.18, 15.45, 17.72
7:00-7:55 p.m.	0000-0055	Sofia, Bulgaria	G	7.115
		Peking, China	F	9.94, 11.675, 11.945
7:00-8:00 p.m.	0000-0100	**VOA, Washington, USA	G	6.19, 9.67, 11.83, 11.895
7:00-9:00 p.m.	0000-0200	**Luxembourg	F	6.09
7:00 p.m.-12:06 a.m.	0000-0506	*Montreal, Canada (Northern Service)	F	6.195, 9.625 (includes Eskimo, etc.)
7:15-7:30 p.m.	0015-0030	Athens, Greece	G	9.75, 9.76, 11.73
7:15-7:40 p.m.	0015-0040	Brussels, Belgium	F	6.08 (9.725 alternates)
7:30-7:55 p.m.	0030-0055	Prague, Czechoslovakia	F	6.055, 9.74
7:30-8:00 p.m.	0030-0100	Stockholm, Sweden	F	6.045
		Kiev, U.S.S.R.	G	6.02, 7.15, 7.205, 7.26, 9.78, 12.05, 15.14, 15.18, 15.455
7:30-10:15 p.m.	0030-0315	Vilnius, U.S.S.R.	G	5.94, 7.355 (Sat., Sun.)
		London, England	G	5.975, 6.12, 6.175 (both via Sackville), 7.32, 9.51 (via Greenville), 9.58, 15.26 (both via Ascension)
7:30 p.m.-2:00 a.m.	0030-0700	HCB, Quito, Ecuador	G	6.095, 9.56, 11.915 (includes some Eskimo)
8:00-8:15 p.m.	0100-0115	Vatican, City	G	5.995, 6.015, 9.605
8:00-8:20 p.m.	0100-0120	Rome, Italy	F	6.01, 9.575
8:00-8:30 p.m.	0100-0130	Montreal, Canada	F	9.535
		Moscow, U.S.S.R.	G	4.86, 5.94, 6.02, 6.125, 7.105, 7.115 (via Bulgaria), 7.15, 7.205, 7.355, 7.44, 9.635, 9.78, 9.79, 9.80, 12.05, 15.14, 15.45
8:00-8:45 p.m.	0100-0145	Berlin, Ger. Dem. Rep.	P	9.73
8:00-8:55 p.m.	0100-0155	Prague, Czechoslovakia	G	5.93, 7.345, 9.54, 9.63, 9.74
		Peking, China	G	7.12, 9.78 (both via Albania)
8:00-10:00 p.m.	0100-0300	Melbourne, Australia	P	9.94, 11.945, 12.055
8:00-10:30 p.m.	0100-0330	Havana, Cuba	P	15.32, 17.795
8:00-11:00 p.m.	0100-0400	Madrid, Spain	G	9.685, 11.725
8:10-8:30 p.m.	0110-0130	**Santiago, Chile	G	6.065, 11.88 (exc. Sun.)
8:30-8:50 p.m.	0130-0150	Cologne, Ger. Fed. Rep.	F	9.566, 11.81, 15.15
			G	6.01, 6.04, 6.075, (both via Antigua), 6.10 (via Malta), 9.565, 9.59 (via Antigua or Montserrat) 9.69, 9.745, 11.685 (via Malta)
8:30-8:55 p.m.	0130-0155	Tirana, Albania	G	6.20, 7.30
8:30-9:00 p.m.	0130-0200	Vienna, Austria	P	6.155, 9.77
		Moscow, U.S.S.R.	G	4.86, 5.94, 6.02, 6.125, 7.105, 7.115, (via Bulgaria), 7.15, 7.205, 7.355, 7.44, 9.635, 9.78, 9.79, 9.80, 11.86, 12.05, 15.14
8:30-9:25 p.m.	0130-0225	Bucharest, Romania	F	5.99, 6.19, 9.57, 9.68, 11.775, 11.94
8:45-9:15 p.m.	0145-0215	Berne, Switzerland	G	5.965, 6.135, 9.725, 11.715
9:00-9:30 p.m.	0200-0230	Budapest, Hungary	G	6.00, 7.215, 9.585, 11.91 (Exc. Sun.)
		Oslo, Norway	F	6.18, 9.55, 9.645 (Sun.)
		Warsaw, Poland	P	6.095, 6.135, 7.27, 9.675, 11.815, 15.12
9:00-9:50 p.m.	0200-0250	Hilversum, Holland	G	6.165 (via Bonaire; time tentative)
9:00-9:55 p.m.	0200-0255	Peking, China	P	7.06, 9.94, 12.055
9:00-10:00 p.m.	0200-0300	Moscow, U.S.S.R.	G	4.86, 5.94, 6.02, 6.125, 7.105, 7.115 (via Bulgaria), 7.205, 7.26, 7.355, 9.635, 9.78, 9.79, 9.80, 11.86, 12.05, 15.14
9:00-10:30 p.m.	0200-0330	Cairo, Egypt	F	7.12, 9.475
9:10-9:30 p.m.	0210-0230	**Santiago, Chile	F	9.566, 11.81, 15.15
9:15-9:30 p.m.	0215-0230	Athens, Greece	G	9.75, 9.76, 11.73
9:30-9:55 p.m.	0230-0255	Tirana, Albania	G	6.20, 7.30
9:30-10:00 p.m.	0230-0300	Stockholm, Sweden	F	6.045, 9.695
10:00-10:30 p.m.	0300-0330	Budapest, Hungary	G	6.00, 7.215, 9.585, 11.91
		Kiev, U.S.S.R.	G	5.98, 6.02, 7.245, 7.26, 7.40, 9.58, 9.78, 11.86

NOW! **THE ORIGINAL** **"3rd Hand"**

Makes Circuit Assembly a Breeze!

Lets you work with Both Hands

STEP 1
Clamp "3rd Hand" on bench, insert circuit board, position components — note convenient working angle.

STEP 2
Flip circuit board to flat position for soldering and clipping. Reverse procedure for double sided boards.

Dealer/Distributor Inquiries Invited

Send Check or Money Order

ORDER NOW!

Fully Guaranteed (Not sold in stores) No C.O.D.'s + .75 Postage

THE 3RD HAND
P.O. BOX 60579
SACRAMENTO, CA 95860

Amount Enclosed \$
California residents add 6% tax

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

CIRCLE NO. 42 ON FREE INFORMATION CARD

FREE **catalog**

of over **2000** small tools, measuring instruments, and supplies

National Camera, Inc.
SALES OF INSTRUMENTS, MEASURING TOOLS, ETC.

ELT. COL. DRILLS FILM LOADERS. PS. PAGES. GRAVERS GRINDERS. HAMMERS. INCLINOMETERS. JACKS. KNIVES. LATHES. LEATHERETTES. LOUPES. MINIATURE TOOLS. METRIC TOOLS. MULTITESTERS. NEGATIVE FILES. NIPPERS. OILERS. PIN VISES. PLIERS. PROBES. RIFFLERS. SCISSORS. SNARES. SOLDERING SUPPLIES. TEST INSTRUMENTS. TWEEZERS. VIEWERS. VISES. WRENCHES. ADH. ABRASIVES. BOOKS. LIMATORS. EPOXIES. CALIPERS.

25 1952-1977 **silver anniversary**

National Camera
2000 West Union Ave., Dept. 1111
Englewood, Colo., U.S.A. 80110

CIRCLE NO. 37 ON FREE INFORMATION CARD



NEW EICO 700 FREQUENCY COUNTER KIT \$69⁹⁵

At last! A digital counter every CB'er/Hobbyist can afford. Exclusive transmitter-Keyed "sniffer" circuit activates counter only on transmit, giving accurate readout of channel frequency. Standard coax connectors and mounting brackets make mobile installation a snap. IC Digital circuitry. Freq. range: 5 Hz-27 MHz (all 40 CB channels) Accuracy: ± 1 PPM ± 1 Digit. Readout: Five 0.5" LED Displays; 10 MHz crystal oscillator KHz/MHz Timebase switch; Compact design: 2 $\frac{3}{8}$ "H x 6 $\frac{1}{8}$ "W 5 $\frac{1}{8}$ "D. **Assembled \$99.95**

FREE '78 EICO CATALOG

Check reader service card or send 75¢ for first class mail. See your local EICO Dealer or call (212) 272-1134, 9:00 a.m.-5:00 p.m. EST. Major credit cards accepted.

EICO—283 Malta St.,
Brooklyn, N.Y. 11207



CIRCLE NO 22 ON FREE INFORMATION CARD

FREE

BA's 1978 ANNUAL CATALOG!

BA
THE
WORLD'S
MOST COMPLETE
CATALOG
OF
EVERYTHING IN
ELECTRONICS
burstein-applebee

**WRITE FOR
YOUR FREE
COPY NOW!**

**260 PAGE
RADIO, TV &
ELECTRONIC
CATALOG**

Your buying
guide for
Everything
in Electro-
nics... Stereo,
Hi-Fi, TVs,
Radios, Tape
Recorders,
CB, Kits,
Tools, Books
and Elec-
tronic parts.

BURSTEIN-APPLEBEE

Dept. PE-11 3199 MERCIER
KANSAS CITY, MO. 64111

NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____

10:00-10:35 p.m.	0300-0335	Warsaw, Poland	P	6.096, 6.135, 7.27, 9.675, 11.815, 15.12
10:00-10:55 p.m.	0300-0355	Peking, China	G	7.12, 9.78 (both via Albania)
10:00-11:00 p.m.	0300-0400	Buenos Aires, Argentina	G	9.69 (Mon.-Fri.)
		Prague, Czechoslovakia	G	5.93, 7.345, 9.54, 9.63, 9.74
		Moscow, U.S.S.R.	G	4.86, 5.94, 6.125, 7.115 (via Bulgaria), 7.205, 7.355, 9.70 (via Bulgaria)
10:00-11:25 p.m.	0300-0425	**Johannesburg, S. Africa	G	3.995, 5.98, 7.27, 9.585
10:15-10:30 p.m.	0315-0330	London, England	G	5.975, 6.12, 6.175 (both via Sackville), 7.32, 9.51 (via Greenville), 9.58 (via Ascension)
10:30-10:55 p.m.	0330-0355	Tirana, Albania	G	6.20, 7.30
		Vienna, Austria	P	6.155, 9.77
10:30-11:00 p.m.	0330-0400	Helsinki, Finland	P	9.55
10:30-11:30 p.m.	0330-0430	London, England	G	5.975, 6.175 (via Antigua)
10:30-11:50 p.m.	0330-0450	Havana, Cuba	G	9.685, 11.725, 11.76
11:00-11:15 p.m.	0400-0415	Budapest, Hungary	G	6.00, 7.215, 9.585, 11.91 (Tues., Fri.)
11:00-11:25 p.m.	0400-0425	Bucharest, Romania	F	5.99, 6.155, 6.19, 9.57, 9.68, 11.775, 11.94
11:00-11:30 p.m.	0400-0430	Oslo, Norway	P	6.18, 9.55 (Sun.)
11:30 p.m.-12 mdt.	0430-0500	London, England	G	6.175 (via Antigua)
11:50 p.m.-1:00 a.m.	0450-0600	Havana, Cuba	G	11.725, 11.76
12:00 mdt.-12:15 a.m.	0500-0515	Jerusalem, Israel	G	5.90, 7.425, 9.009
12:00 mdt.-12:30 a.m.	0500-0530	Lisbon, Portugal	G	6.025, 11.935
12:00 mdt.-1:30 a.m.	0500-0630	London, England	G	6.175, 9.51 (both via Antigua)
1:30-2:00 a.m.	0630-0700	London, England	G	6.175 (via Antigua)
1:45-3:35 a.m.	0645-0835	**Lagos, Nigeria	G	7.275, 15.12

TO WESTERN NORTH AMERICA

TIME-PST	TIME-GMT	STATION	QUAL*	FREQUENCIES, MHz
3:00-3:15 a.m.	1100-1115	Tokyo, Japan	G	5.99
3:00-4:25 a.m.	1100-1225	Trans-World Radio, Bonaire, N.A.	G	11.815
3:00-5:00 a.m.	1100-1300	London, England	G	5.99 (via Sackville)
		Melbourne, Australia	G	9.58
3:00-6:00 a.m.	1100-1400	**VOA, Washington, USA	G	5.955, 9.73
4:00-4:15 a.m.	1200-1215	Tokyo, Japan	P	5.99
4:00-4:30 a.m.	1200-1230	**Tashkent, U.S.S.R.	F	9.60, 11.925
4:10-4:30 a.m.	1210-1230	**Santiago, Chile	F	9.566, 11.81, 15.15
4:15-4:30 a.m.	1215-1230	HCJB, Quito, Ecuador	G	11.745
5:30-6:00 a.m.	1230-1400	Trans-World Radio Bonaire, N.A.	G	15.255 (Sat., Sun.)
4:30-8:30 a.m.	1230-1630	HCJB, Quito, Ecuador	G	11.745, 15.115
5:00-5:15 a.m.	1300-1315	Tokyo, Japan	P	5.99
5:00-5:30 a.m.	1300-1330	London, England	G	5.99 (via Sackville), 11.77 (via Antigua; Sat., Sun. from 1200)
5:30-7:00 a.m.	1330-1500	**Delhi, India	F	11.81, 15.335
6:00-6:30 a.m.	1400-1430	Tokyo, Japan	G	5.99
		**Tashkent, U.S.S.R.	F	9.60, 11.925
6:00-8:55 a.m.	1400-1655	Manila, Philippines (VOP)	F	9.58 (Closes 1555 Sun.)
7:00-7:15 a.m.	1500-1515	Tokyo, Japan	G	5.99
7:00-8:00 a.m.	1500-1600	London, England	G	17.84 (via Ascension) also 9.58 (via Sackville Sat., Sun.)
8:00-8:15 a.m.	1600-1615	London, England	G	9.58 (via Sackville), 17.84 (via Ascension)
8:15-9:09 a.m.	1615-1709	London, England	G	9.58 (via Sackville, Sat., Sun. to 1745)
8:42-8:50 a.m.	1642-1650	Hilversum, Holland	G	15.19, 17.775 Mon.-Fri., via Bonaire)
9:00-9:15 a.m.	1700-1715	Tokyo, Japan	G	5.99
9:00 a.m.-12 noon	1700-2000	Kuwait, Kuwait	G	9.58, 12.085
9:04-9:56 a.m.	1704-1756	Paris, France	G	9.52, 9.63, 11.705, 11.73, 11.735, 11.745, 11.89, 11.905, 11.93, 15.30, 15.425, 17.72
10:00-10:15 a.m.	1800-1815	Tokyo, Japan	F	5.99
10:00-10:30 a.m.	1800-1830	Oslo, Norway	F	11.895, 15.345 (Sun.)
10:30-11:30 a.m.	1830-1930	Taipei, Taiwan	F	9.51, 11.86, 15.37
11:00-11:07 a.m.	1900-1907	**Papeete, Tahiti	F	11.825, 15.17 (exc. Sun.)
11:00-11:15 a.m.	1900-1915	Tokyo, Japan	G	9.505
12:00-12:15 p.m.	2000-2015	Tokyo, Japan	G	9.505
12 noon-2:00 p.m.	2000-2200	London, England	G	15.26 (via Ascension)
1:00-1:15 p.m.	2100-2115	Tokyo, Japan	G	9.505
2:00-2:15 p.m.	2200-2215	Tokyo, Japan	G	15.105
2:00-3:00 p.m.	2200-2300	London, England	G	6.175, 9.51 (both via Sackville), 15.26 (via Ascension)
2:00-4:00 p.m.	2200-2400	**VOA, Washington, USA	G	17.82, 17.895, 21.61
2:30-3:00 p.m.	2230-2300	Jerusalem, Israel	F	5.90, 7.4125, 9.435, 9.815
2:30-3:20 p.m.	2230-2320	Johannesburg, S. Africa	G	5.98, 9.585, 11.80, 11.90
2:50-3:10 p.m.	2250-2310	**Santiago, Chile	F	9.566, 11.81, 15.15
3:00-3:30 p.m.	2300-2330	Tokyo, Japan	G	15.105
		Vilnius, U.S.S.R.	G	9.61, 11.69, 15.10

3:00-4:30 p.m.	2300-0030	London, England	G	6.175, 9.51 (both via Sackville), 9.58, 15.26 (both via Ascension)
3:00-5:00 p.m.	2300-0100	Montreal, Canada	G	6.04, (5.96 alt.; Mon.-Fri.)
4:00-4:15 p.m.	0000-0015	Tokyo, Japan	G	15.105
4:00-5:00 p.m.	0000-0100	**VOA, Washington, USA	G	11.83, 11.895, 15.40
4:30-5:30 p.m.	0030-0130	**Trans-World Radio Bonaire, N.A.	G	11.925
4:30-7:15 p.m.	0030-0315	London, England	G	6.12, 6.175 (both via Sackville), 9.51 (via Greenville), 9.58, 15.26 (both via Ascension)
4:30-11:00 p.m.	0030-0700	HCJB, Quito, Ecuador	G	6.095, 9.56, 11.915 (includes some Eskimo)
5:00-5:15 p.m.	0100-0115	Tokyo, Japan	G	15.105
5:00-7:00 p.m.	0100-0300	Melbourne, Australia	G	15.32, 17.795
5:00-8:00 p.m.	0100-0400	Madrid, Spain	F	6.065, 11.88 (exc. Sun.)
5:10-5:30 p.m.	0110-0130	**Santiago, Chile	F	9.566, 11.81, 15.15
5:30-6:30 p.m.	0130-0230	Tokyo, Japan	G	11.84, 15.195, 15.42, 17.825
6:00-6:15 p.m.	0200-0215	Tokyo, Japan	G	15.105
6:00-7:50 p.m.	0200-0350	Taipei, Taiwan	G	15.345, 17.89
6:10-6:30 p.m.	0210-0230	**Santiago, Chile	G	9.566, 11.81, 15.15
6:30-7:00 p.m.	0230-0300	Stockholm, Sweden	F	6.045, 9.695
7:00-7:30 p.m.	0300-0330	Kiev, U.S.S.R.	G	5.98, 6.02, 7.245, 7.26, 7.40, 9.58, 9.78, 11.86
		Montreal, Canada	G	5.96, 6.00, 9.605, 9.655
7:00-7:55 p.m.	0300-0355	Peking, China	G	7.12, 9.78 (both via Albania)
7:00-8:25 p.m.	0300-0425	**Johannesburg, S. Africa	G	9.46, 9.94, 11.65, 12.055
7:10-7:30 p.m.	0310-0330	**Santiago, Chile	G	3.995, 5.98, 7.27, 9.585
7:15-7:30 p.m.	0315-0330	London, England	G	9.566, 11.81, 15.15
			G	6.12, 6.175 (both via Sackville), 9.51 (via Greenville), 9.58 (via Ascension)
7:20-8:25 p.m.	0320-0425	**TIFC, San Jose, Costa Rica	F	6.035, 9.645, (opens 0300 Sat., Sun.)
7:22-7:28 p.m.	0322-0378	Erevan, U.S.S.R.	G	11.69, 11.96, 15.13, 15.18, 15.455 (Sat./Tue./Wed./Fri.)
7:30-8:00 p.m.	0330-0400	Moscow, U.S.S.R.	G	5.905, 6.02, 7.26, 9.54, 9.58, 9.61, 9.635, 9.735, 9.78, 11.69
7:30-8:15 p.m.	0330-0415	Berlin, Ger. Dem. Rep.	P	5.955, 6.08, 9.73
7:30-8:30 p.m.	0330-0430	London, England	G	6.175 (via Antigua)
8:00-8:15 p.m.	0400-0415	Tokyo, Japan	G	9.505
8:00-8:30 p.m.	0400-0430	Oslo, Norway	P	9.645 (Sun.)
		Budapest, Hungary	P	6.00, 7.215, 9.585, 11.91 (Tue., Fri.)
		Montreal, Canada	G	5.96, 9.655
8:00-8:55 p.m.	0400-0455	Peking, China	G	9.46, 9.94, 11.65, 12.055
8:00-9:00 p.m.	0400-0500	Moscow, U.S.S.R.	G	5.905, 6.02, 7.175, 7.26, 9.54, 9.58, 9.61, 9.635, 9.735, 11.69
8:30-9:00 p.m.	0430-0500	Berne, Switzerland	F	6.045, 9.725
		Vienna, Austria	P	6.015
		Sofia, Bulgaria	F	9.53
9:00-9:15 p.m.	0500-0515	Jerusalem, Israel	F	5.90, 7.4125, 9.009
		Tokyo, Japan	G	9.505
9:00-9:30 p.m.	0500-0530	Lisbon, Portugal	P	6.025, 11.935
9:00-9:50 p.m.	0500-0550	Hilversum, Holland	G	6.165, 9.715, (via Bonaire; time tentative)
9:00-9:30 p.m.	0500-0530	Moscow, U.S.S.R.	G	5.905, 6.02, 7.11, 7.26, 9.52, 9.54, 9.58, 9.61, 9.635, 9.735
9:00-10:30 p.m.	0500-0630	London, England	G	6.175, 9.51, (both via Antigua)
9:30-9:50 p.m.	0530-0550	Cologne, Ger. Fed. Rep.	G	5.96 (via Antigua)
			G	6.10 (via Malta), 6.185, 9.545, 9.605, 11.765
9:30-10:00 p.m.	0530-0600	Moscow, U.S.S.R.	G	5.905, 6.02, 7.11, 7.175, 7.22, 7.26, 7.30, 9.52, 9.54, 9.58, 9.635, 9.735
10:00-10:30 p.m.	0600-0630	Oslo, Norway	P	6.18, 9.645 (Sun.)
		Moscow, U.S.S.R.	G	6.02, 7.11, 7.15, 7.175, 7.22, 7.26, 7.30, 9.54, 9.58, 9.635, 9.735
			G	9.69 (Mon.-Fri.)
10:00-11:00 p.m.	0600-0700	Buenos Aires, Argentina	G	6.175 (via Antigua)
10:30-11:00 p.m.	0630-0700	London, England	G	6.02, 7.11, 7.15, 7.175, 7.22, 7.26, 7.30, 9.54, 9.58, 9.635, 9.735
10:30-11:30 p.m.	0630-0730	Moscow, U.S.S.R.	G	9.525
10:30 p.m.-12 mdt.	0630-0800	Havana, Cuba	G	7.22, 11.90, 15.275
10:30 p.m.-12:55 a.m.	0630-0855	**Kuala Lumpur, Malaysia	G	9.505
11:00-11:15 p.m.	0700-0715	Tokyo, Japan	G	9.63 (via Bonaire)
11:30 p.m.-12:20 a.m.	0730-0820	**Hilversum, Holland	G	6.105
11:30 p.m.-2:30 a.m.	0730-1030	**Wellington, New Zealand	G	
12 mdt.-12:15 a.m.	0800-0815	Tokyo, Japan	G	9.505
12 mdt.-6:00 a.m.	0800-1400	**Port Moresby, Papua-New Guinea	G	4.89
1:00-1:15 a.m.	0900-0915	Tokyo, Japan	G	9.505
2:00-2:30 a.m.	1000-1030	Tokyo, Japan	G	5.99
2:00-2:50 a.m.	1000-1050	Pyongyang, Dem. Rep. Korea	G	7.213

*Reception quality, East Coast (West Coast) location: G-good, F-fair, P-poor

**Not intended for North America, but receivable satisfactorily
Days refer to local date in target area.



Includes
Functional
Tilt Stand!

NEW EICO 270 3 1/2 DIGIT DMM KIT ONLY \$79.95

Introductory Offer—FREE AC ADAPTOR

The first and only lab accuracy portable DMM Kit featuring MOS/LSI IC economy and reliability. Measures DC/AC Volts, Kilohms, DC/AC milliamps in 21 ranges. Polarity indicators and overload protection are provided, and 0.5 inch LED displays give easiest-to-read digital readout to 1999. The 270 features a basic 0.5% DC accuracy, 10 Megohm input impedance, low voltage drop in all current ranges and automatically-flashing overrange indicator. **Assembled \$109.95**

FREE '78 EICO CATALOG

Check reader service card or send 75¢ for first class mail. See your local EICO Dealer or call (212) 272-1134, 9:00 a.m.-5:00 p.m. EST. Major credit cards accepted.

EICO—283 Malta St., Brooklyn, N.Y. 11207



CIRCLE NO. 22 ON FREE INFORMATION CARD

SAVE!

MONEY • TIME • FREIGHT

- QUALITY STEREO EQUIPMENT AT LOWEST PRICES.
- YOUR REQUEST FOR QUOTATION RETURNED SAME DAY.
- FACTORY SEALED CARTONS—GUARANTEED AND INSURED.
- SAVE ON NAME BRANDS LIKE:

PIONEER	SANSUI
KENWOOD	DYNACO
SHURE	SONY
MARANTZ	KOSS

**AND MORE THAN 50 OTHERS
BUY THE MODERN WAY
BY MAIL—FROM**



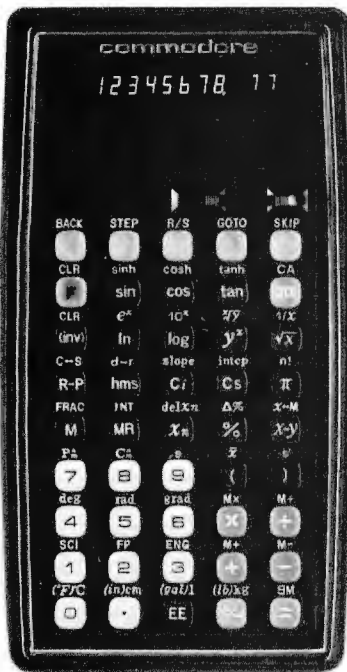
illinois audio

12 East Delaware
Chicago, Illinois 60611
312-664-0020

CIRCLE NO. 31 ON FREE INFORMATION CARD

The Affordable Programmable

Never Before A Fully Programmable Calculator
Available To The Scientific Community At Such A Low Cost!



by Mail Order

\$59⁹⁵

CALL TOLL FREE

800-323-2272

24 HOURS - 7 DAYS

SUMMARY OF SPECIFICATIONS

- 12 DIGIT RED L.E.D. DISPLAY entries or results in 3 modes, scientific, fixed point or engineering
- PROGRAMMABLE - 72 Keystroke program storage
- TRIG FUNCTIONS - Calculates in radians or degrees or grads
- HYPERBOLIC FUNCTIONS
- Ln, log, e^x, 10^x
- POWERS Y^x, Roots ^x/Y
- FUNCTIONS OF X - 1/x, \sqrt{x}
- LINEAR REGRESSION: TREND ANALYSIS: SLOPE AND INTERCEPT
- STATISTICAL: Σ , Σ -, averages, standard deviation, variance, permutations, combinations
- PERCENTAGE CALCULATION - add on/discount/yield Δ percentage
- π AND CHANGE SIGN KEY
- 10 MEMORIES - 7 functions - M+, M-, MR, Mx, M \div , STORE, 9M
- DEGREES/DEGREE, MINUTE, SECONDS CONVERSION
- RADIAN/DEGREE CONVERSION
- POLAR/RECTANGULAR CONVERSION
- 8 METRIC CONVERSIONS
- SPHERICAL/CARTESIAN CONVERSIONS

The Commodore PR (Personal Resource) 100 - Allows You To Personally Program According To Your Own Problem-Solving Needs!

WHY A PROGRAMMABLE?

The Commodore PR-100 Programmable Calculator introduces a new, innovative dimension in highly sophisticated mathematical and scientific problem-solving. It decentralizes and personalizes the decision-making power of the computer, bringing to you what was never before available in a programmable calculator with such features, yet at an amazingly affordable price.

Method of Entry: The Commodore PR-100 is designed for "Think and Touch" operation utilizing an algebraic mode of entry. You can enter equations which have up to 4 levels of parenthesis. Add to these features the 10 memory registers, and you can work the most complicated mathematical, scientific, engineering, business, statistical and combinational functions. Furthermore, you can also perform unit conversions: metric to English and English to metric.

Keyboard: The keyboard consists of 40 keys and 2 switches. 35 keys are for number and function entry. 10 of these keys are dual function (shifted keys).

SPECIALIZED FUNCTIONS:

Most of the important functions found on large scale computer systems are finally now available to you on the ultimate hand-held programmable calculator: iterative and recursive problem solving techniques; looping; conditional and unconditional branching.

ADVANTAGES OF THIS PROGRAMMABLE:

Consider for a moment the advantages of the Commodore PR-100. In terms of increased productivity you can now achieve the capability of: optimizing mathematical and scientific models; making trend and risk analyses; projecting and forecasting more accurately; performing statistical reductions; automating time-consuming "number-crunching."

The PR-100 is also a pre-programmed calculator that can achieve a multitude of functions: Basic $+$ - \times \div and = functions; clear entry or the entire calculation; Hyperbolic functions include: sinh, cosh, arc cosh and arc tan; Trigonometric functions include: sin x, cos x, tan x, arc sin x, arc cos x, and arc tan x. Calculates in radians, degrees or gradians. Enter x 0° to 360° (0 to 2 π) or multiples of 360° (2 π). Natural Log (Ln x), Common Log (log x), Exponential (e^x), Antilog (10^x); Algebraic Functions include: x, x², 1/x. Powers: (Y^x); π (pi). Change Sign (+/-); \leftrightarrow exchange function; Parenthesis () enter equations that contain up to 4 levels of parenthesis without using temporary or intermediate storage.

Memory Functions: The PR-100 has 10 separate memory registers. For each memory there are 7 operations that can be performed: memory storage and clear, recall, addition, subtraction, multiplication, division and performs the desired functions on each memory.

NO LANGUAGE TO LEARN

Truly this programmable calculator is a powerful personal scientific and mathematical computing resource. And you don't need to know programming to make it work for you. There is no special language to learn. The entry system is so easy and flexible to use that you can apply it quickly to your own personal problem-solving techniques and style.

Special Functions of the PR-100: To allow you greater flexibility in programming, there are 3 special functions: 1. HALT - The program will halt and allow the user to read or enter data. 2. GOTO - Allows branching from one section of a program to another. 3. SKIP - Allows conditional flow of a program on an intermediate result; that is - the program goes one way if an answer is negative and another way is positive.

Loading, Editing and Modifying Programs: You can single step through a program to check it out, backstep through a program, easily read entered steps and modify a single step of a program.

Now personal programming is here. A step-function increase in capability over sophisticated slide-rule calculators. Capability you won't fully discover until you own a PR-100 yourself. Fill out the coupon below or call our toll free number for your two week trial.

The Commodore PR-100 is powered by rechargeable NiCad batteries and is furnished with an AC adapter/charger, leatherette carrying case and full instruction booklet. One year manufacturer's warranty. Dimensions: 3 1/4" x 6 1/2" x 1 1/8". Weight: 4 oz.

Compute With It For Two Weeks - No Obligation

Please send Commodore PR-100 Calculator(s) at the introductory price of only \$59.95 (plus \$3.95 shipping and insurance) each. If not completely satisfied, I can return it within two weeks for a prompt refund.

☐ Instead, I/we would like to take advantage of your quantity price offering of \$54.95 (plus \$3.95 shipping and insurance) each. OFFER GOOD ONLY ON QUANTITIES OF 6 UNITS OR MORE! You can save \$30.00!

☐ Check or M.O. Enclosed (Ill. residents add 5% sales tax)
☐ Please charge my credit card checked below:
☐ American Express ☐ BankAmericard ☐ Carte Blanche
☐ Diners Club ☐ Master Charge

Credit Card # _____

Master Charge Bank # _____ Exp. Date _____

Name _____

Address _____

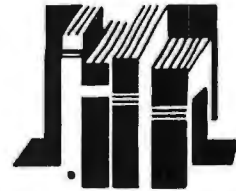
City _____ State _____ Zip _____

Signature _____ PEMA305



Send Coupon To
Contemporary Marketing, Inc.
790 Maple Lane, Bensenville, Ill. 60106

Call Toll Free: 800-323-2272, Ill. call: 312-595-0461



Electronics Library

TELEPHONE ACCESSORIES YOU CAN BUILD

by Jules H. Gilder

The telephone has the potential of being much more than a simple communication device. It can, for example, remotely control other appliances, automatically dial any number when tripped by an alarm, code phone conversations to insure privacy, and even act as an intruder alarm when equipped with the proper accessories. This book illustrates with schematics and text how to build a number of accessories at very low cost. Included are two chapters devoted to telephone basics and pertinent telephone regulations. Among the accessories described are a "hands-free" system, security scrambler, automatic dialer, answering machine, and burglar alarm.

Published by Hayden Book Co., Inc., 50 Essex St., Rochelle Park, NJ 07662. Soft cover. 84 pages. \$3.95.

RADIO OPERATORS LICENSE HANDBOOK (THIRD EDITION)

by Edward Noll

The laws, rules, regulations, and accepted operating procedures for licensed (up to Second Class) and nonlicensed persons are covered in this book. The first four chapters give information and explanations on the materials needed to obtain lower-grade FCC operating licenses. The last three chapters contain Q&A's based on FCC Elements I, II, and IX.

Published by Howard W. Sams & Co., 4300 W. 62nd St., Indianapolis, IN 46206. 224 pages \$5.50, soft cover.

SC/MP MICROPROCESSOR APPLICATIONS

This handbook contains detailed information for building, checking out, and operating a host of National Semiconductor SC/MP-microprocessor-based systems. It is conveniently organized to enable the designer to expand, modify, and customize a particular application with minimum effort. Chapter one deals with general design data and contains such basic SC/MP application parameters as instruction sets, addressing structures. (Additional information on general-purpose applications is given in the appendix. Chapter two has applications data organized into sections according to class: A/D and D/A systems, keyboard and display systems, multi-processor systems, etc.

Published by National Semiconductor Corp., Marketing Services (520), 2900 Semiconductor Dr., Santa Clara, CA 95051. Soft cover. \$5.00.

MORE THAN 20,000 DIFFERENT COMPONENTS

7400 TTL

7400	.18	7442	1.08	74107	.49
7401	.21	7448	1.15	74121	.55
7402	.21	7450	.26	74122	.49
7403	.21	7451	.27	74123	1.05
7405	.24	7453	.27	74125	.60
7407	.45	7454	.41	74126	.81
7408	.25	7460	.22	74132	3.00
7409	.25	7472	.39	74141	1.15
7410	.20	7473	.45	74150	1.10
7411	.30	7474	.45	74151	1.25
7413	.85	7475	.80	74153	1.35
7416	.43	7482	1.75	74154	1.54
7417	.43	7483	1.15	74157	1.30
7420	.21	7485	1.12	74161	1.45
7422	1.50	7486	.45	74164	1.65
7425	.43	7489	2.49	74165	1.65
7427	.37	7490	.69	74166	1.70
7428	.35	7491	1.20	74174	1.95
7430	.26	7492	.82	74175	1.95
7432	.31	7493	.82	74180	1.05
7437	.47	7494	.91	74181	3.55
7438	.40	7495	.91	74191	1.50
7440	.21	7496	.91	74195	1.00
7441	1.10	74100	1.25	74197	1.00

74L SERIES TTL

74L00	.33	74LS04	.45	74LS113	.98
74L10	.33	74LS10	.39	74LS138	1.89
74L30	.33	74LS20	.39	74LS174	2.50
74L42	1.50	74LS51	.39	74LS386	5.50
74L86	.69	74LS74	.65	74LS513	2.25
74LS00	.39	74LS112	.65	74LS387	1.95

74H00 TTL

74H00	.33	74H11	.33	74H53	.39
74H01	.33	74H20	.33	74H55	.39
74H04	.33	74H21	.33	74H73	.59
74H05	.35	74H30	.33	74H74	.59
74H10	.33	74H40	.33	74H76	.65

MOTOROLA

MC663P	2.50	MC1460	3.95
MC666P	1.60	MC1469R	2.50
MC670P	1.60	MC1489	4.60
MC679P	2.50	MC1496	1.65
MC725P	1.50	MC1510G	8.00
MC789P	1.50	MC1514L	4.50
MC790P	1.50	MC1595L	6.25
MC817P	1.30	MC1723CL	3.60
MC836P	1.35	MC1741CG	1.20
MC844	1.25	MC1810P	1.25
MC853P	2.25	MC3004L	2.25
MC876P	2.25	MC3007P	2.25
MC1004L	1.25	MC3021L	2.15
MC1010L	1.25	MC3060L	2.65
MC1305	1.95	MC3062L	3.00
MC1352P	1.55	MC4024P	2.20
MC1357	1.70	MC4044P	4.80
MC1371	1.85	MC14507CP	1.25
MC1439	2.65	MC14511CP	2.75
MC1458P	.50	MC14512CP	1.70

C MOS

4001AE	.29	4023AE	.29
4002AE	.29	4024AE	1.50
4007AE	.29	4025AE	1.35
4010AE	.58	4028AE	1.60
4011AE	.29	4029AE	2.90
4012AE	.29	4030AE	2.65
4015AE	1.25	4037AE	4.50
4016AE	.65	4040AE	2.40
4018AE	1.10	4044AE	1.50
4019AE	.65	4049AE	.75
4020AE	1.75	4050AE	.75
4021AE	1.50		

LINEAR

75450BP	.49	LM301H	.35	LM741CH	.45
75451BP	.39	LM307H	.35	LM747	.90
75452BP	.39	LM309K	1.25	LM1458N	.80
75453BP	.39	LM311H	.90	NE555V	1.50
75454BP	.39	LM318N	1.50	NE555V	1.00
75491BP	.79	LM339N	1.85	NE555V	1.00
75492BP	.85	LM351AN	.85	NE555V	1.00
CA3005	1.60	LM370N	1.25	NE555V	1.50
CA3006	3.50	LM380N	1.45	UA702	.80
CA3018	1.10	LM566	2.25	UA703CH	.45
CA3018A	1.60	LM711CH	.60	UA709CH	.30
CA3026	1.50	LM723H	.75	UA749CH	.45
CA3048	.35	LM741CN	.45		

NEW FROM NEW-TONE

Dry Transfer Patterns for PC Boards, Includes IC pads, donuts, angles, and 3-and 4-conductor pads. Over 225 patterns on a 2" x 7 1/4" sheet . . . \$1.49

PC BOARDS - MIL GRADE

Glass-epoxy. 2 oz. copper.

6" x 3" \$.50 • 6" x 6" \$.90 • 6" x 8" \$1.20

5400 SERIES

5400	1.00	5475	1.50	LM340K-5	1.95
5404	1.25	5486	1.90	LM340K-6	1.95
5410	1.00	5493	2.00	LM340K-8	1.95
5426	1.25	54100	1.80	LM340K-15	1.95
5473	1.50	54LS04	1.00	LM340K-18	1.95

VOLT.REG

LM340K-5	1.95
LM340K-6	1.95
LM340K-8	1.95
LM340K-15	1.95
LM340K-18	1.95
LM340K-24	1.95
LM340T0-5	1.75
LM340T0-8	1.75
LM340T0-12	1.75
LM340T0-15	1.75
LM340T0-18	1.75
LM340T0-24	1.75

RESISTORS

1/4 Watt ± 5% Packed 5 of any one value . . . \$25
1/2 Watt ± 5% Packed 5 of any one value . . . \$30
STANDARD RESISTANCE VALUES

MINIMUM ORDER \$5.00

All orders add \$1.00 Postage and Handling.

Canada \$1.50.

N.J. Residents add 5% sales tax

ELECTROLYTIC CAPACITORS

2.2MF50	Axial Leads	.15	30MF25	Axial Leads	.18
3.3MF10	Axial Leads	.15	47MF25	Axial Leads	.19
3.3MF10	No Polarity	.15	47MF50	Radial Leads	.24
10MF25	Axial Leads	.15	100MF18	Radial Leads	.19
10MF50	Axial Leads	.16	100MF25	Radial Leads	.24
10MF150	Axial Leads	.20	500MF50	Axial Leads	.60
25MF35	Axial Leads	.18	1000MF35	Axial Leads	.65

MICROPROCESSOR

C1702A	9.95	2708	34.95	8008	19.95
2101	5.75	C5101-3	4.50	8080A	19.95
2102	1.75	MM5013	3.25	8224	10.45

Contact us for all your microprocessor needs.

JAPANESE TRANSISTORS

2SA473	.75	2SC373	.70	2SC778	3.00	2SC1306	4.75	2SD180	2.75
2SA484	3.00	2SC374	.70	2SC777	4.00	2SC1307	5.75	2SD187	.80
2SA489	.80	2SC375	.65	2SC778	4.00	2SC1308	4.75	2SD188	.95
2SA495	1.65	2SC380	.70	2SC781	3.00	2SC1317	.60	2SD201	1.95
2SA496	1.15	2SC381	.70	2SC784	.70	2SC1318	.70	2SD213	3.75
2SA497	1.00	2SC382	.70	2SC785	1.00	2SC1327	.70	2SD218	4.75
2SA562	.70	2SC387	.70	2SC788	2.15	2SC1342	.70	2SD223	4.50
2SA564	.50	2SC394	.70	2SC789	1.00	2SC1347	.50	2SD234	1.00
2SA606	4.25	2SC403	.65	2SC790	1.75	2SC1359	.65	2SD235	1.00
2SA628	.65	2SC454	.65	2SC793	2.50	2SC1377	5.50	2SD257	2.00
2SA634	1.25	2SC458	.70	2SC798	3.10	2SC1382	1.00	2SD261	.80
2SA638	1.25	2SC460	.70	2SC799	3.50	2SC1383	.75	2SD287	4.00
2SA643	.85	2SC478	.80	2SC815	.75	2SC1384	.85	2SD288	1.00
2SA673	.85	2SC481	1.85	2SC821	4.00	2SC1447	1.25	2SD291	.85
2SA678	.75	2SC482	1.75	2SC828	.75	2SC1448	1.25	2SD300	2.50
2SA679	3.75	2SC484	3.75	2SC829	.75	2SC1449	1.30	2SD313	1.10
2SA680	3.75	2SC485	3.25	2SC830	1.80	2SC1475	1.50	2SD314	1.10
2SA682	.85	2SC493	2.75	2SC838	.70	2SC1507	1.25	2SD315	.75
2SA683	.90	2SC494	3.50	2SC839	.85	2SC1569	1.25	2SD318	.95
2SA684	.95	2SC495	1.10	2SC853	1.00	2SC1675	1.75	2SD325	1.25
2SA699	1.30	2SC496	1.15	2SC868	5.85	2SC1678	5.50	2SD330	1.00
2SA699A	1.45	2SC497	1.60	2SC871	.70	2SC1679	4.75	2SD331	.90
2SA706	.55	2SC502	1.50	2SC900	.70	2SC1728	2.15	2SD360	3.25
2SA733	.65	2SC509	1.25	2SC922	.55	2SC1730	1.60	2SD360	1.50
2SA777	.90	2SC515	.80	2SC929	.70	2SC1766	1.25	2SCF8	3.50
2SB22	.65	2SC517	4.25	2SC930	.65	2SC1758	1.25	2SCF8	1.25
2SB54	.70	2SC535	.75	2SC938	.65	2SC1816	4.50	2SF8	3.00
2SB56	.70	2SC536	.65	2SC945	.65	2SC1908	.70	HEPS3001	3.25
2SB77	.70	2SC537	.70	2SC1000	.65	2SC1909	4.75	JSP7001	.75
2SB175	.55	2SC608	4.90	2SC1013	1.50	2SC1957	1.50	MRFR8004	3.00
2SB186	.60	2SC609	4.90	2SC1014	1.50	2SC1964	4.75	MPS8000	1.25
2SB187	.60	2SC614	3.80	2SC1017	1.50	2SC1973	1.50	MPS8001	1.25
2SB324	1.00	2SC619	.70	2SC1018	1.50	2SC1974	4.50	MPS8002	1.25
2SB327	1.75	2SC620	.80	2SC1034	3.50	2SC1978	5.50	MPS8003	4.00
2SB367	1.60	2SC627	1.75	2SC1080	.75	2SC2020	2.50	SD1074	19.95
2SB370	.65	2SC634A	.65	2SC1081	1.65	2SC2027	6.00	SD1076	28.95
2SB405	.65	2SC644	.70	2SC1097	3.75	2SC2028	1.10	SK3047	3.75
2SB407	1.65	2SC674	.60	2SC1080	3.75	2SC2029	4.75	SK3048	3.25
2SB415	.85	2SC708	3.80	2SC1096	1.20	2SC2034	3.00	SK3049	4.75
2SB435	.75	2SC710	.70	2SC1098	1.15	2SC2074	3.00	SK3054	1.25
2SB461	1.25	2SC711	.70	2SC1115	2.75	2SC2075	5.50	SK319	1.75
2SB463	1.65	2SC712	.70	2SC1116	4.00	2SC2091	1.10	2SK30A	1.00
2SB474	1.50	2SC715	.70	2SC1124	1.25	2SC2092	4.75	2SK33	1.20
2SB481	2.10	2SC730	.65	2SC1166	.70	2SC2166	4.75	2SK41	1.75
2SB492	1.25	2SC731	3.00	2SC1170	4.00	2SD45	2.00	SK322Y	2.75
2SB495	.95	2SC732	.70	2SC1172	4.00	2SD68	.90	SK340	2.75
2SB507	.90	2SC733	.70	2SC1173	4.25	2SD72	4.50	SK345	2.75
2SB511	.70	2SC734	.70	2SC1174	.95	2SD77	1.00	SK349	2.75
2SC116	3.00	2SC735	.70	2SC1209	.75	2SD81	3.25	4004	3.00
2SC183	1.00	2SC738	.70	2SC1211	.75	2SD88	1.50	4005	3.00
2SC184	1.00	2SC756	3.00	2SC1213	1.00	2SD92	1.50	40080	1.25
2SC281	.65	2SC763	.70	2SC1226A	1.25	2SD118	3.25	40081	1.50
2SC371	.70	2SC774	1.75	2SC1237	4.50	2SD130	1.25	40082	3.00
2SC372	.70	2SC775	2.75	2SC1239	4.00	2SD170	2.00		

IC's ON THE MOVE

BBD BUCKET BRIGADE DEVICE			
	MM3001	19.50	MN3002 11.70 MM3003 9.45
HALL IC:	DN834	1.25	DN837 1.50
	DN835	1.35	DN838 (NEW)

7400N TTL

SN7400N	.18	SN7472N	.39	SN74160N	1.25
SN7401N	.18	SN7473N	.39	SN74161N	.99
SN7402N	.20	SN7474N	.50	SN74163N	.99
SN7403N	.20	SN7475N	.50	SN74164N	.99
SN7404N	.20	SN7476N	.35	SN74165N	.99
SN7405N	.20	SN7477N	5.00	SN74166N	1.25
SN7406N	.20	SN7478N	.50	SN74167N	2.25
SN7407N	.35	SN7479N	.89	SN74170N	2.10
SN7408N	.20	SN7480N	.89	SN74171N	6.00
SN7409N	.20	SN7481N	.89	SN74172N	6.00
SN7410N	.20	SN7482N	.39	SN74173N	1.50
SN7411N	.20	SN7483N	3.50	SN74174N	1.25
SN7412N	.20	SN7484N	2.49	SN74175N	.99
SN7413N	.69	SN7485N	.45	SN74176N	.79
SN7414N	.79	SN7486N	.75	SN74177N	.79
SN7415N	.35	SN7487N	.49	SN74178N	2.49
SN7416N	.35	SN7488N	.49	SN74179N	2.49
SN7417N	.20	SN7489N	.99	SN74180N	2.49
SN7418N	.20	SN7490N	.79	SN74181N	2.49
SN7419N	.39	SN7491N	.79	SN74182N	.95
SN7420N	.39	SN7492N	.79	SN74183N	1.95
SN7421N	.39	SN7493N	3.00	SN74184N	1.95
SN7422N	.39	SN7494N	1.25	SN74185N	1.95
SN7423N	.39	SN7495N	1.25	SN74186N	1.95
SN7424N	.39	SN7496N	1.25	SN74187N	1.95
SN7425N	.39	SN7497N	1.25	SN74188N	1.95
SN7426N	.39	SN7498N	1.25	SN74189N	1.95
SN7427N	.39	SN7499N	1.25	SN74190N	1.95
SN7428N	.39	SN7500N	1.25	SN74191N	1.25
SN7429N	.39	SN7501N	1.25	SN74192N	1.25
SN7430N	.39	SN7502N	1.25	SN74193N	.99
SN7431N	.39	SN7503N	1.25	SN74194N	1.25
SN7432N	.39	SN7504N	1.25	SN74195N	.75
SN7433N	.39	SN7505N	1.25	SN74196N	1.00
SN7434N	.39	SN7506N	1.25	SN74197N	1.00
SN7435N	.39	SN7507N	1.25	SN74198N	1.75
SN7436N	.39	SN7508N	1.25	SN74199N	1.75
SN7437N	.39	SN7509N	1.25	SN74200N	5.59
SN7438N	.39	SN7510N	1.25	SN74201N	5.59
SN7439N	.39	SN7511N	1.25	SN74202N	5.59
SN7440N	.39	SN7512N	1.25	SN74203N	5.59
SN7441N	.39	SN7513N	1.25	SN74204N	5.59
SN7442N	.39	SN7514N	1.25	SN74205N	5.59
SN7443N	.39	SN7515N	1.25	SN74206N	5.59
SN7444N	.39	SN7516N	1.25	SN74207N	5.59
SN7445N	.39	SN7517N	1.25	SN74208N	5.59
SN7446N	.39	SN7518N	1.25	SN74209N	5.59
SN7447N	.39	SN7519N	1.25	SN74210N	5.59
SN7448N	.39	SN7520N	1.25	SN74211N	5.59
SN7449N	.39	SN7521N	1.25	SN74212N	5.59
SN7450N	.39	SN7522N	1.25	SN74213N	5.59
SN7451N	.39	SN7523N	1.25	SN74214N	5.59
SN7452N	.39	SN7524N	1.25	SN74215N	5.59
SN7453N	.39	SN7525N	1.25	SN74216N	5.59
SN7454N	.39	SN7526N	1.25	SN74217N	5.59
SN7455N	.39	SN7527N	1.25	SN74218N	5.59
SN7456N	.39	SN7528N	1.25	SN74219N	5.59
SN7457N	.39	SN7529N	1.25	SN74220N	5.59
SN7458N	.39	SN7530N	1.25	SN74221N	5.59
SN7459N	.39	SN7531N	1.25	SN74222N	5.59
SN7460N	.39	SN7532N	1.25	SN74223N	5.59
SN7461N	.39	SN7533N	1.25	SN74224N	5.59
SN7462N	.39	SN7534N	1.25	SN74225N	5.59
SN7463N	.39	SN7535N	1.25	SN74226N	5.59
SN7464N	.39	SN7536N	1.25	SN74227N	5.59
SN7465N	.39	SN7537N	1.25	SN74228N	5.59
SN7466N	.39	SN7538N	1.25	SN74229N	5.59
SN7467N	.39	SN7539N	1.25	SN74230N	5.59
SN7468N	.39	SN7540N	1.25	SN74231N	5.59
SN7469N	.39	SN7541N	1.25	SN74232N	5.59
SN7470N	.39	SN7542N	1.25	SN74233N	5.59
SN7471N	.39	SN7543N	1.25	SN74234N	5.59
SN7472N	.39	SN7544N	1.25	SN74235N	5.59
SN7473N	.39	SN7545N	1.25	SN74236N	5.59
SN7474N	.39	SN7546N	1.25	SN74237N	5.59
SN7475N	.39	SN7547N	1.25	SN74238N	5.59
SN7476N	.39	SN7548N	1.25	SN74239N	5.59
SN7477N	.39	SN7549N	1.25	SN74240N	5.59
SN7478N	.39	SN7550N	1.25	SN74241N	5.59
SN7479N	.39	SN7551N	1.25	SN74242N	5.59
SN7480N	.39	SN7552N	1.25	SN74243N	5.59
SN7481N	.39	SN7553N	1.25	SN74244N	5.59
SN7482N	.39	SN7554N	1.25	SN74245N	5.59
SN7483N	.39	SN7555N	1.25	SN74246N	5.59
SN7484N	.39	SN7556N	1.25	SN74247N	5.59
SN7485N	.39	SN7557N	1.25	SN74248N	5.59
SN7486N	.39	SN7558N	1.25	SN74249N	5.59
SN7487N	.39	SN7559N	1.25	SN74250N	5.59
SN7488N	.39	SN7560N	1.25	SN74251N	5.59
SN7489N	.39	SN7561N	1.25	SN74252N	5.59
SN7490N	.39	SN7562N	1.25	SN74253N	5.59
SN7491N	.39	SN7563N	1.25	SN74254N	5.59
SN7492N	.39	SN7564N	1.25	SN74255N	5.59
SN7493N	.39	SN7565N	1.25	SN74256N	5.59
SN7494N	.39	SN7566N	1.25	SN74257N	5.59
SN7495N	.39	SN7567N	1.25	SN74258N	5.59
SN7496N	.39	SN7568N	1.25	SN74259N	5.59
SN7497N	.39	SN7569N	1.25	SN74260N	5.59
SN7498N	.39	SN7570N	1.25	SN74261N	5.59
SN7499N	.39	SN7571N	1.25	SN74262N	5.59
SN7500N	.39	SN7572N	1.25	SN74263N	5.59

20% Discount for 100 Combined 7400's

CMOS

CD4001	2.25	CD4044	.89	CD4086	2.25
CD4002	.23	CD4046	1.79	MC14653	3.50
CD4007	.25	CD4047	2.50	74200 Series	
CD4009	.49	CD4048	1.35	74200	.39
CD4010	.49	CD4049	1.35	74202	.35
CD4011	.23	CD4050	.49	74204	.75
CD4012	.25	CD4051	1.19	74204	.85
CD4013	.39	CD4053	1.19	74214	3.00
CD4014	1.39	CD4054	1.49	74220	.55
CD4015	1.19	CD4059	9.25	74230	.85
CD4016	.49	CD4062	1.49	74242	2.15
CD4017	1.19	CD4068	.79	74273	1.50
CD4018	.99	CD4069	.39	74274	1.15
CD4019	.49	CD4070	.45	74289	4.00
CD4020	1.19	CD4075	.55	74290	.30
CD4021	1.39	CD4071	.23	74293	2.00
CD4022	1.39	CD4073	1.39	74297	2.00
CD4023	.23	CD4077	.23	74307	1.25
CD4024	.79	CD4082	.23	743151	2.90
CD4025	.23	MC14409	14.95	743154	.30
CD4026	2.25	MC14410	14.95	743157	2.15
CD4027	.89	MC14419	4.95	743180	.75
CD4028	.23	MC14506	.75	743181	3.25
CD4029	1.19	MC14507	.99	743183	.30
CD4030	.49	CD4508	.99	743164	3.25
CD4031	.23	CD4510	1.35	743173	2.50
CD4040	1.19	CD4511	1.29	743193	2.75
CD4041	1.25	CD4515	2.95	743195	2.75
CD4042	.99	CD4518	1.29	80655	1.50
CD4043	.89	CD4520	1.29	80657	1.50

DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

**I.C.'S • RESISTORS • TRANSISTORS • CAPACITORS • DIODES • I.C. SOCKETS & PINS • SWITCHES
CLOCK MODULES • OPTOELECTRONICS • BREADBOARDING & TESTING DEVICES • DRAFTING SUPPLIES
DATA BOOKS • HEAT SINKS • WIRE • TOOLS... AND MORE... WRITE FOR FREE CATALOG**

INTEGRATED CIRCUITS

7400	21	74198	1.49	7415261	2.00	LF357N	1.20
7401	21	74221	1.49	7415266	3.28	LF13741	1.76
7402	21	74251	1.09	7415272	67	LM301A	44
7403	21	74298	94	7415283	79	LM308N	1.00
7404	21	74365	67	7415283	65	LM309K	1.00
7405	21	74366	67	7415291	1.12	LM317T	3.00
7406	25	74367	67	7415298	1.30	LM317MP	1.00
7407	25	74368	67	7415365	67	LM324MP-1	2.70
7408	21			7415366	67	LM324MP-2	1.30
7409	21			7415367	67	LM324MP-3	1.30
7410	21	741500	26	7415377	1.50	LM324MP-151	2.30
7411	21	741501	26	7415395	1.74	LM324MP-181	3.00
7412	21	741502	26	7415400	2.34	LM324MP-181	3.00
7413	25	741503	26	7415402	2.34	LM324MP-181	3.00
7414	89	741504	29	7415403	2.34	LM324MP-181	3.00
7415	25	741505	29	7415404	2.34	LM324MP-21	3.00
7416	25	741506	29	7415405	2.34	LM324MP-21	3.00
7417	25	741507	29	7415406	2.34	LM324MP-21	3.00
7418	25	741508	29	7415407	2.34	LM324MP-21	3.00
7419	25	741509	29	7415408	2.34	LM324MP-21	3.00
7420	21	741510	28	7415409	2.34	LM324MP-21	3.00
7421	25	741511	28	7415410	2.34	LM324MP-21	3.00
7422	25	741512	28	7415411	2.34	LM324MP-21	3.00
7423	25	741513	28	7415412	2.34	LM324MP-21	3.00
7424	25	741514	28	7415413	2.34	LM324MP-21	3.00
7425	25	741515	28	7415414	2.34	LM324MP-21	3.00
7426	25	741516	28	7415415	2.34	LM324MP-21	3.00
7427	33	741517	1.02	7415416	2.34	LM324MP-21	3.00
7428	28	741518	1.02	7415417	2.34	LM324MP-21	3.00
7429	21	741519	28	7415418	2.34	LM324MP-21	3.00
7430	21	741520	28	7415419	2.34	LM324MP-21	3.00
7431	21	741521	28	7415420	2.34	LM324MP-21	3.00
7432	21	741522	28	7415421	2.34	LM324MP-21	3.00
7433	21	741523	28	7415422	2.34	LM324MP-21	3.00
7434	21	741524	28	7415423	2.34	LM324MP-21	3.00
7435	21	741525	28	7415424	2.34	LM324MP-21	3.00
7436	21	741526	28	7415425	2.34	LM324MP-21	3.00
7437	21	741527	28	7415426	2.34	LM324MP-21	3.00
7438	21	741528	28	7415427	2.34	LM324MP-21	3.00
7439	21	741529	28	7415428	2.34	LM324MP-21	3.00
7440	21	741530	28	7415429	2.34	LM324MP-21	3.00
7441	21	741531	28	7415430	2.34	LM324MP-21	3.00
7442	21	741532	28	7415431	2.34	LM324MP-21	3.00
7443	21	741533	28	7415432	2.34	LM324MP-21	3.00
7444	21	741534	28	7415433	2.34	LM324MP-21	3.00
7445	21	741535	28	7415434	2.34	LM324MP-21	3.00
7446	21	741536	28	7415435	2.34	LM324MP-21	3.00
7447	21	741537	28	7415436	2.34	LM324MP-21	3.00
7448	21	741538	28	7415437	2.34	LM324MP-21	3.00
7449	21	741539	28	7415438	2.34	LM324MP-21	3.00
7450	21	741540	28	7415439	2.34	LM324MP-21	3.00
7451	21	741541	28	7415440	2.34	LM324MP-21	3.00
7452	21	741542	28	7415441	2.34	LM324MP-21	3.00
7453	21	741543	28	7415442	2.34	LM324MP-21	3.00
7454	21	741544	28	7415443	2.34	LM324MP-21	3.00
7455	21	741545	28	7415444	2.34	LM324MP-21	3.00
7456	21	741546	28	7415445	2.34	LM324MP-21	3.00
7457	21	741547	28	7415446	2.34	LM324MP-21	3.00
7458	21	741548	28	7415447	2.34	LM324MP-21	3.00
7459	21	741549	28	7415448	2.34	LM324MP-21	3.00
7460	21	741550	28	7415449	2.34	LM324MP-21	3.00
7461	21	741551	28	7415450	2.34	LM324MP-21	3.00
7462	21	741552	28	7415451	2.34	LM324MP-21	3.00
7463	21	741553	28	7415452	2.34	LM324MP-21	3.00
7464	21	741554	28	7415453	2.34	LM324MP-21	3.00
7465	21	741555	28	7415454	2.34	LM324MP-21	3.00
7466	21	741556	28	7415455	2.34	LM324MP-21	3.00
7467	21	741557	28	7415456	2.34	LM324MP-21	3.00
7468	21	741558	28	7415457	2.34	LM324MP-21	3.00
7469	21	741559	28	7415458	2.34	LM324MP-21	3.00
7470	21	741560	28	7415459	2.34	LM324MP-21	3.00
7471	21	741561	28	7415460	2.34	LM324MP-21	3.00
7472	21	741562	28	7415461	2.34	LM324MP-21	3.00
7473	21	741563	28	7415462	2.34	LM324MP-21	3.00
7474	21	741564	28	7415463	2.34	LM324MP-21	3.00
7475	21	741565	28	7415464	2.34	LM324MP-21	3.00
7476	21	741566	28	7415465	2.34	LM324MP-21	3.00
7477	21	741567	28	7415466	2.34	LM324MP-21	3.00
7478	21	741568	28	7415467	2.34	LM324MP-21	3.00
7479	21	741569	28	7415468	2.34	LM324MP-21	3.00
7480	21	741570	28	7415469	2.34	LM324MP-21	3.00
7481	21	741571	28	7415470	2.34	LM324MP-21	3.00
7482	21	741572	28	7415471	2.34	LM324MP-21	3.00
7483	21	741573	28	7415472	2.34	LM324MP-21	3.00
7484	21	741574	28	7415473	2.34	LM324MP-21	3.00
7485	21	741575	28	7415474	2.34	LM324MP-21	3.00
7486	21	741576	28	7415475	2.34	LM324MP-21	3.00
7487	21	741577	28	7415476	2.34	LM324MP-21	3.00
7488	21	741578	28	7415477	2.34	LM324MP-21	3.00
7489	21	741579	28	7415478	2.34	LM324MP-21	3.00
7490	21	741580	28	7415479	2.34	LM324MP-21	3.00
7491	21	741581	28	7415480	2.34	LM324MP-21	3.00
7492	21	741582	28	7415481	2.34	LM324MP-21	3.00
7493	21	741583	28	7415482	2.34	LM324MP-21	3.00
7494	21	741584	28	7415483	2.34	LM324MP-21	3.00
7495	21	741585	28	7415484	2.34	LM324MP-21	3.00
7496	21	741586	28	7415485	2.34	LM324MP-21	3.00
7497	21	741587	28	7415486	2.34	LM324MP-21	3.00
7498	21	741588	28	7415487	2.34	LM324MP-21	3.00
7499	21	741589	28	7415488	2.34	LM324MP-21	3.00
7500	21	741590	28	7415489	2.34	LM324MP-21	3.00
7501	21	741591	28	7415490	2.34	LM324MP-21	3.00
7502	21	741592	28	7415491	2.34	LM324MP-21	3.00
7503	21	741593	28	7415492	2.34	LM324MP-21	3.00
7504	21	741594	28	7415493	2.34	LM324MP-21	3.00
7505	21	741595	28	7415494	2.34	LM324MP-21	3.00
7506	21	741596	28	7415495	2.34	LM324MP-21	3.00
7507	21	741597	28	7415496	2.34	LM324MP-21	3.00
7508	21	741598	28	7415497	2.34	LM324MP-21	3.00
7509	21	741599	28	7415498	2.34	LM324MP-21	3.00
7510	21	741600	28	7415499	2.34	LM324MP-21	3.00
7511	21	741601	28	7415500	2.34	LM324MP-21	3.00
7512	21	741602	28	7415501	2.34	LM324MP-21	3.00
7513	21	741603	28	7415502	2.34	LM324MP-21	3.00
7514	21	741604	28	7415503	2.34	LM324MP-21	3.00
7515	21	741605	28	7415504	2.34	LM324MP-21	3.00
7516	21	741606	28	7415505	2.34	LM324MP-21	3.00
7517	21	741607	28	7415506	2.34	LM324MP-21	3.00
7518	21	741608	28	7415507	2.34	LM324MP-21	3.00
7519	21	741609	28	7415508	2.34	LM324MP-21	3.00
7520	21	741610	28	7415509	2.34	LM324MP-21	3.00
7521	21	741611	28	7415510	2.34	LM324MP-21	3.00
7522	21	741612	28	7415511	2.34	LM324MP-21	3.00
7523	21	741613	28	7415512	2.34	LM324MP-21	3.00
7524	21	741614	28	7415513	2.34	LM324MP-21	3.00
7525	21	741615	28	7415514	2.34	LM324MP-21	3.00
7526	21	741616	28	7415515	2.34	LM324MP-21	3.00
7527	21	741617	28	7415516	2.34	LM324MP-21	3.00
7528	21	741618	28	7415517	2.34	LM324MP-21	3.00
7529	21	741619	28	7415518	2.34	LM324MP-21	3.00
7530	21	741620	28	7415519	2.34	LM324MP-21	3.00
7531	21	741621	28	7415520	2.34	LM324MP-21	3.00
7532	21	741622	28	7415521	2.34	LM324MP-21	3.00
7533	21	741623	28	7415522	2.34	LM324MP-21	3.00
7534	21	741624	28	7415523	2.34	LM324MP-21	3.00
7535	21	741625	28	7415524	2.34	LM324MP-21	3.00
7536	21	741626	28	7415525	2.34	LM324MP-21	3.00
7537	21	741627	28	7415526	2.34	LM324MP-21	3.00
7538	21	741628	28	7415527	2.34	LM324MP-21	3.00
7539	21	741629	28	7415528	2.34	LM324MP-21	3.00
7540	21	741630	28	7415529	2.34	LM324MP-21	3.00

7400	21	74198	1.49	7415261	2.00	LF357N	1.20
7401	21	74221	1.49	7415266	3.28	LF13741	1.76
7402	21	74251	1.09	7415272	67	LM301A	44
7403	21	74298	94	7415283	79	LM308N	1.00
7404	21	74365	67	7415283	65	LM309K	1.00
7405	21	74366	67	7415291	1.12	LM317T	3.00
7406	25	74367	67	7415298	1.30	LM317MP	1.00
7407	25	74368	67	7415365	67	LM324MP-1	2.70
7408	21			7415366			

EXAR IC'S

COMMUNICATION CIRCUITS

XR-2208CP Four-Quadrant Operational Multiplier **\$5.20**

PHASE-LOCKED LOOPS

XR-210 FSK Modulator/Demodulator **\$5.20**
XR-215 General Purpose Phase-Locked Loop **\$6.56**
XR-2211CP FSK Demodulator/Tone Decoder **\$6.88**

FUNCTION GENERATORS

XR-205 Waveform Generator **\$8.40**
XR-2206CP Monolithic Function Generator **\$5.12**
XR-2207CP Current-Controlled Oscillator **\$3.84**

TONE DECODERS

XR-567CP Tone Decoder **\$1.68**
XR-5677CP Dual Tone Decoder **\$5.18**

VOLTAGE REGULATORS

XR-1468CN Dual ± 15 Volt Tracking Regulator **\$3.84**
XR-4194CN Adjustable Dual Tracking Voltage Regulator **\$4.56**
XR-4195CP Dual ± 15 Volt Tracking Voltage Regulator **\$3.38**

OPERATIONAL AMPLIFIERS

XR3403CP Quad Operational Amplifier **\$3.33**
XR-4202P Programmable Quad Operational Amplifier **\$3.60**
XR-4212CP Quad Operational Amplifier **\$2.05**
XR-4558CP Dual Operational Amplifier **\$0.86**
XR-4739CP Dual Low-Noise Operational Amplifier **\$1.15**

TIMING CIRCUITS

XR-320P Timing Circuit **\$1.52**
XR-555CP Timing Circuit **\$1.07**
XR-556CP Dual 555 Timing Circuit **\$1.82**
XR-2240CP Programmable Timing Circuit **\$3.44**
XR-2556CP Dual 555 Timing Circuit **\$3.20**

INTERFACE CIRCUITS

XR-2200CP Hammer Driver **\$1.17**
XR-2201CP/ High Voltage, High Current 2202CP/2203 Darlington Transistor Arrays **\$2.25 ea**
XR-2204CP **\$2.25 ea**

OTHER CIRCUITS

XR-2271CP Fluorescent Display Drivers **\$1.15**
XR-1310P FM Stereo Demodulator **\$3.20**
XR-2264CP Proportional Servo IC **\$4.24**
XR-4161CP Voltage-To-Frequency Converter **\$7.50**

ADVANCED MICRO DEVICES, INC.

AMD

COMPUTER INTERFACE CIRCUITS

1-8	10 UP	1-8	10 UP
AM2501CN	\$2.80	AM2501CN	\$2.80
AM2502CN	\$2.80	AM2502CN	\$2.80
AM2503CN	\$2.80	AM2503CN	\$2.80
AM2504CN	\$2.80	AM2504CN	\$2.80
AM2505CN	\$2.80	AM2505CN	\$2.80
AM2506CN	\$2.80	AM2506CN	\$2.80
AM2507CN	\$2.80	AM2507CN	\$2.80
AM2508CN	\$2.80	AM2508CN	\$2.80
AM2509CN	\$2.80	AM2509CN	\$2.80
AM2510CN	\$2.80	AM2510CN	\$2.80
AM2511CN	\$2.80	AM2511CN	\$2.80
AM2512CN	\$2.80	AM2512CN	\$2.80
AM2513CN	\$2.80	AM2513CN	\$2.80
AM2514CN	\$2.80	AM2514CN	\$2.80
AM2515CN	\$2.80	AM2515CN	\$2.80
AM2516CN	\$2.80	AM2516CN	\$2.80
AM2517CN	\$2.80	AM2517CN	\$2.80
AM2518CN	\$2.80	AM2518CN	\$2.80
AM2519CN	\$2.80	AM2519CN	\$2.80
AM2520CN	\$2.80	AM2520CN	\$2.80

BI-POLAR MICROPROCESSOR AND SUPPORT CIRCUITS

1-8	10 UP	1-8	10 UP
AM2501CN	\$2.80	AM2501CN	\$2.80
AM2502CN	\$2.80	AM2502CN	\$2.80
AM2503CN	\$2.80	AM2503CN	\$2.80
AM2504CN	\$2.80	AM2504CN	\$2.80
AM2505CN	\$2.80	AM2505CN	\$2.80
AM2506CN	\$2.80	AM2506CN	\$2.80
AM2507CN	\$2.80	AM2507CN	\$2.80
AM2508CN	\$2.80	AM2508CN	\$2.80
AM2509CN	\$2.80	AM2509CN	\$2.80
AM2510CN	\$2.80	AM2510CN	\$2.80
AM2511CN	\$2.80	AM2511CN	\$2.80
AM2512CN	\$2.80	AM2512CN	\$2.80
AM2513CN	\$2.80	AM2513CN	\$2.80
AM2514CN	\$2.80	AM2514CN	\$2.80
AM2515CN	\$2.80	AM2515CN	\$2.80
AM2516CN	\$2.80	AM2516CN	\$2.80
AM2517CN	\$2.80	AM2517CN	\$2.80
AM2518CN	\$2.80	AM2518CN	\$2.80
AM2519CN	\$2.80	AM2519CN	\$2.80
AM2520CN	\$2.80	AM2520CN	\$2.80

BI-POLAR MEMORY

1-8	10 UP	1-8	10 UP
AM2501CN	\$2.80	AM2501CN	\$2.80
AM2502CN	\$2.80	AM2502CN	\$2.80
AM2503CN	\$2.80	AM2503CN	\$2.80
AM2504CN	\$2.80	AM2504CN	\$2.80
AM2505CN	\$2.80	AM2505CN	\$2.80
AM2506CN	\$2.80	AM2506CN	\$2.80
AM2507CN	\$2.80	AM2507CN	\$2.80
AM2508CN	\$2.80	AM2508CN	\$2.80
AM2509CN	\$2.80	AM2509CN	\$2.80
AM2510CN	\$2.80	AM2510CN	\$2.80
AM2511CN	\$2.80	AM2511CN	\$2.80
AM2512CN	\$2.80	AM2512CN	\$2.80
AM2513CN	\$2.80	AM2513CN	\$2.80
AM2514CN	\$2.80	AM2514CN	\$2.80
AM2515CN	\$2.80	AM2515CN	\$2.80
AM2516CN	\$2.80	AM2516CN	\$2.80
AM2517CN	\$2.80	AM2517CN	\$2.80
AM2518CN	\$2.80	AM2518CN	\$2.80
AM2519CN	\$2.80	AM2519CN	\$2.80
AM2520CN	\$2.80	AM2520CN	\$2.80

SILICON GATE MOS LSI

1-8	10 UP	1-8	10 UP
AM2501CN	\$2.80	AM2501CN	\$2.80
AM2502CN	\$2.80	AM2502CN	\$2.80
AM2503CN	\$2.80	AM2503CN	\$2.80
AM2504CN	\$2.80	AM2504CN	\$2.80
AM2505CN	\$2.80	AM2505CN	\$2.80
AM2506CN	\$2.80	AM2506CN	\$2.80
AM2507CN	\$2.80	AM2507CN	\$2.80
AM2508CN	\$2.80	AM2508CN	\$2.80
AM2509CN	\$2.80	AM2509CN	\$2.80
AM2510CN	\$2.80	AM2510CN	\$2.80
AM2511CN	\$2.80	AM2511CN	\$2.80
AM2512CN	\$2.80	AM2512CN	\$2.80
AM2513CN	\$2.80	AM2513CN	\$2.80
AM2514CN	\$2.80	AM2514CN	\$2.80
AM2515CN	\$2.80	AM2515CN	\$2.80
AM2516CN	\$2.80	AM2516CN	\$2.80
AM2517CN	\$2.80	AM2517CN	\$2.80
AM2518CN	\$2.80	AM2518CN	\$2.80
AM2519CN	\$2.80	AM2519CN	\$2.80
AM2520CN	\$2.80	AM2520CN	\$2.80

ZENER DIODES

WATT	PRICE
1W2200	2.7 .22
1W2200	2.8 .22
1W2200	3.0 .22
1W2200	3.3 .22
1W2200	3.6 .22
1W2200	3.9 .22
1W2200	4.2 .22
1W2200	4.5 .22
1W2200	4.8 .22
1W2200	5.1 .22
1W2200	5.4 .22
1W2200	5.7 .22
1W2200	6.0 .22
1W2200	6.3 .22
1W2200	6.6 .22
1W2200	6.9 .22
1W2200	7.2 .22
1W2200	7.5 .22
1W2200	7.8 .22
1W2200	8.1 .22
1W2200	8.4 .22
1W2200	8.7 .22
1W2200	9.0 .22
1W2200	9.3 .22
1W2200	9.6 .22
1W2200	9.9 .22
1W2200	10.2 .22
1W2200	10.5 .22
1W2200	10.8 .22
1W2200	11.1 .22
1W2200	11.4 .22
1W2200	11.7 .22
1W2200	12.0 .22
1W2200	12.3 .22
1W2200	12.6 .22
1W2200	12.9 .22
1W2200	13.2 .22
1W2200	13.5 .22
1W2200	13.8 .22
1W2200	14.1 .22
1W2200	14.4 .22
1W2200	14.7 .22
1W2200	15.0 .22
1W2200	15.3 .22
1W2200	15.6 .22
1W2200	15.9 .22
1W2200	16.2 .22
1W2200	16.5 .22
1W2200	16.8 .22
1W2200	17.1 .22
1W2200	17.4 .22
1W2200	17.7 .22
1W2200	18.0 .22
1W2200	18.3 .22
1W2200	18.6 .22
1W2200	18.9 .22
1W2200	19.2 .22
1W2200	19.5 .22
1W2200	19.8 .22
1W2200	20.1 .22
1W2200	20.4 .22
1W2200	20.7 .22
1W2200	21.0 .22
1W2200	21.3 .22
1W2200	21.6 .22
1W2200	21.9 .22
1W2200	22.2 .22
1W2200	22.5 .22
1W2200	22.8 .22
1W2200	23.1 .22
1W2200	23.4 .22
1W2200	23.7 .22
1W2200	24.0 .22
1W2200	24.3 .22
1W2200	24.6 .22
1W2200	24.9 .22
1W2200	25.2 .22
1W2200	25.5 .22
1W2200	25.8 .22
1W2200	26.1 .22
1W2200	26.4 .22
1W2200	26.7 .22
1W2200	27.0 .22
1W2200	27.3 .22
1W2200	27.6 .22
1W2200	27.9 .22
1W2200	28.2 .22
1W2200	28.5 .22
1W2200	28.8 .22
1W2200	29.1 .22
1W2200	29.4 .22
1W2200	29.7 .22
1W2200	30.0 .22
1W2200	30.3 .22
1W2200	30.6 .22
1W2200	30.9 .22
1W2200	31.2 .22
1W2200	31.5 .22
1W2200	31.8 .22
1W2200	32.1 .22
1W2200	32.4 .22
1W2200	32.7 .22
1W2200	33.0 .22
1W2200	33.3 .22
1W2200	33.6 .22
1W2200	33.9 .22
1W2200	34.2 .22
1W2200	34.5 .22
1W2200	34.8 .22
1W2200	35.1 .22
1W2200	35.4 .22
1W2200	35.7 .22
1W2200	36.0 .22
1W2200	36.3 .22
1W2200	36.6 .22
1W2200	36.9 .22
1W2200	37.2 .22
1W2200	37.5 .22
1W2200	37.8 .22
1W2200	38.1 .22
1W2200	38.4 .22
1W2200	38.7 .22
1W2200	39.0 .22
1W2200	39.3 .22
1W2200	39.6 .22
1W2200	39.9 .22
1W2200	40.2 .22
1W2200	40.5 .22
1W2200	40.8 .22
1W2200	41.1 .22
1W2200	41.4 .22
1W2200	41.7 .22
1W2200	42.0 .22
1W2200	42.3 .22
1W2200	42.6 .22
1W2200	42.9 .22
1W2200	43.2 .22
1W2200	43.5 .22
1W2200	43.8 .22
1W2200	44.1 .22
1W2200	44.4 .22
1W2200	44.7 .22
1W2200	45.0 .22
1W2200	45.3 .22
1W2200	45.6 .22
1W2200	45.9 .22
1W2200	46.2 .22
1W2200	46.5 .22
1W2200	46.8 .22
1W2200	47.1 .22
1W2200	47.4 .22
1W2200	47.7 .22
1W2200	48.0 .22
1W2200	48.3 .22
1W2200	48.6 .22
1W2200	48.9 .22
1W2200	49.2 .22
1W2200	49.5 .22
1W2200	49.8 .22
1W2200	50.1 .22
1W2200	50.4 .22
1W2200	50.7 .22
1W2200	51.0 .22
1W2200	51.3 .22
1W2200	51.6 .22
1W2200	51.9 .22
1W2200	52.2 .22
1W2200	52.5 .22
1W2200	52.8 .22
1W2200	53.1 .22
1W2200	53.4 .22
1W2200	53.7 .22
1W2200	54.0 .22
1W2200	54.3 .22
1W2200	54.6 .22
1W2200	54.9 .22
1W2200	55.2 .22
1W2200	55.5 .22
1W2200	55.8 .22
1W2200	56.1 .22
1W2200	56.4 .22
1W2200	56.7 .22
1W2200	57.0 .22
1W2200	57.3 .22
1W2200	57.6 .22
1W2200	57.9 .22
1W2200	58.2 .22
1W2200	58.5 .22
1W2200	58.8 .22
1W2200	59.1 .22
1W2200	59.4 .22
1W2200	59.7 .22
1W2200	60.0 .22
1W2200	60.3 .22
1W2200	60.6 .22
1W2200	60.9 .22
1W2200	61.2 .22
1W2200	61.5 .22
1W2200	61.8 .22
1W2200	62.1 .22
1W2200	62.4 .22
1W2200	62.7 .22
1W2200	63.0 .22
1W2200	63.3 .22
1W2200	63.6 .22
1W2200	63.9 .22
1W2200	64.2 .22
1W2200	64.5 .22
1W2200	64.8 .22
1W2200	65.1 .22
1W2200	65.4 .22
1W2200	65.7 .22
1W2200	66.0 .22
1W2200	66.3 .22
1W2200	66.6 .22
1W2200	66.9 .22
1W2200	67.2 .22
1W2200	67.5 .22
1W2200	67.8 .22
1W2200	68.1 .22
1W2200	68.4 .22
1W2200	68.7 .22
1W2200	69.0 .22
1W2200	69.3 .22
1W2200	69.6 .22
1W2200	69.9 .22
1W2200	70.2 .22
1W2200	70.5 .2

PRECISION TIMER
INTEGRATED CIRCUIT

- Extremely simple, requiring only one external timing resistor and capacitor.
- 12 stage counter provides time intervals up to 7500 CR.
- Low internal current consumption of 5 mA allows battery operation. Output current drive capability of 25 mA.
- Excellent temperature stability <0.01%/°C.
- Accurate repetitive timing 0.01% typical.
- On-chip regulator or TTL supply option.
- Complementary TTL compatible outputs.
- Internal/external clamping facility.
- Main, contact, or TTL triggered timing sequence initiation.
- Repetitive and cascade operation.

ZN1034E \$3.60
Data Sheet/Application Note .46

UNIVERSAL COUNT/DISPLAY
INTEGRATED CIRCUIT

- 4 digit counter • Switch-on reset
- Up/down synchronous counting.
- Separate memory latches.
- Anticipatory carry/borrow output.
- Carrying by direct connections.
- Separate B.C.D. and segment outputs.
- Blanking, including mark/space intensity control.
- Automatic zero suppression.
- Self scan system including int. osc.
- Control of internal scanning oscillator for synchronization.
- Inhibit and clear. • Lamp test.
- 50 mA minimum segment drive capability (180 mA typical).
- 5V supply/TTL compatible interfacing.
- Count rate exceeding 5MHz.
- Schmitt input on count.

ZN1040E \$15.00
Data Sheet/Application Note .45

MICROPROCESSOR CRYSTALS

FREQ (MHz)	CASE	P/N	PRICE	FREQ (MHz)	CASE	P/N	PRICE
1.00	HC33	CY1A	\$8.55	10.00	HC18	CY12A	\$4.35
2.00	HC33	CY2A	6.75	14.318	HC18	CY14A	4.35
3.2768	HC33	CY3B	4.80	15.00	HC18	CY15A	4.35
4.00	HC18	CY3A	4.80	18.00	HC18	CY19A	4.35
4.434	HC18	CY4C	4.80	20.00	HC18	CY22A	7.20
5.00	HC18	CY7A	4.80	23.684	HC18	CY23B	4.35
5.068	HC18	CY5B	4.80	27.00	HC18	CY27A	4.35
5.7143	HC18	CY5C	4.80	32.00	HC18	CY30B	4.35
6.00	HC18	CY6B	4.80				

MOTOROLA EDUCATOR II
MICROCOMPUTER HEP KIT

- Motorola M6800 Technology
 - Test-as-you-build in easy steps — normally one evening assembly.
 - Completely self-contained with all parts, cabinet and instructional manual.
- Get started in the fascinating world of Micro Computers for only **\$169.95**

EDUCATOR II
POWER SUPPLY KIT

- 5 V @ 1.0 Amps
 - Designed specifically for Educator II Microcomputer Kit
 - Complete Kit — all parts, cabinet and construction manual
- \$29.95**

DIODES

IN914	10/1.00
IN4002	10/1.00
IN4003	10/1.00
IN4004	10/1.00
IN4005	10/1.10
IN4006	10/1.20
IN4007	10/1.20

MN6040 C-MOS PLL — a single-chip phase-locked loop intended for use as a frequency synthesizer in CB transceivers and other communications equipment. **\$7.90**

Miniature
Toggle Switches

7101	29
7103 (CENTER OFF)	1.94
DOUBLE POLE DOUBLE THROW	
7201	2.24
7203 (CENTER OFF)	2.56

PLESSEY SAMPLER

300 METALIZED CAPACITORS 18 DIFFERENT VALUES	\$26.00
--	---------

TO-220 VOLTAGE
REGULATOR FROM
FAIRCHILD

7805C 5V	7815C 15V
7806C 6V	7818C 18V
7812C 12V	7824C 24V

2 for \$1.20

RESISTOR ASSORTMENTS

Each assortment contains 5 pcs each of 10 different values. Values included are shown in (Ohms)

1/4W 5% (50 pcs total) ... \$1.75 / 1/2W 5% (50 pcs total) ... \$1.85

Ass't. 1: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56 ohm

Ass't. 2: 68, 82, 100, 120, 150, 180, 220, 270, 330, 390 ohm

Ass't. 3: 470, 560, 680, 820 ohm, 1K, 1.2K, 1.5K, 1.8K, 2.2K, 2.7K

Ass't. 4: 3.3K, 3.9K, 4.7K, 5.6K, 6.8K, 8.2K, 10K, 12K, 15K, 18K

Ass't. 5: 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K

Ass't. 6: 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K

Ass't. 7: 1M, 1.2M, 1.5M, 1.8M, 2.2M, 2.7M, 3.3M, 3.9M, 4.7M, 5.6M, (1/2W Assortment No. 7 doesn't include 5.6M)

Ass't. 8 (All seven assortments above)

1/4W 5% 350 pcs total \$10.95 1/2W 5% 350 pcs total \$11.55

★ E-Z-HOOK ★

E-Z Hooks have been designed and field tested through the industry to save time and money in commercial electronic production and servicing. The spring-loaded hook attaches firmly, yet so gently it will not damage component — frees hands while testing. Durably constructed and fully insulated to a single contact point assuring true readings. Meets exacting laboratory and space age computer technology requirements. AVAILABLE IN 10 RETMA COLORS: Red, black, blue, green, orange, yellow, white, violet, brown or gray.

MICRO HOOK

XM Micro Hook (1.75" long < 1 gram) for difficult IC Testing. Permits hookups to delicate wiring where weight and leverage may damage component. \$80 ea.

Specify color. ORDER P/N XM

Jumper with XM
Micro Hooks

Order No.	Length	Price
204XM-12"	12"	\$1.70
204XM-24"	24"	1.70

Specify color

XM-S MICRO HOOK SET (Includes 1 ea. red, black, blue, green, orange, yellow, white, brown, violet and gray Micro Hook). At this low price you can afford more than one set.

COMPLETE SET (10) MICRO HOOKS \$7.95

MINI HOOK

X100W Mini Hook (2.25" long) combines rugged construction, miniature size and Finger-ase Hyga Action for all the best test connections. Hook is large enough for component leads, yet small enough to get into tight places. \$75 ea.

Specify color. ORDER P/N X100W

Jumper with X-100W
Mini Hooks

Order No.	Length	Price
204-12W	12"	\$1.60
204-24W	24"	1.60

Specify color.

Jumper X-100W Mini Hook to Stacking Banana Plug

Order No.	Length	Price
201W	32"	\$1.35

Specify color.

Jumper with X-100W Mini Hook

Order No.	Length	Price
201XM	32"	\$1.40

Specify color.

EXTRA LONG MINI HOOK

XL-1 Mini Hook (5.0" long) combines all the proven features of the X100W with an extra long body. It will make safe, short-free test connections in card racks and through deep wiring nest up to 4" ... ORDER P/N XL-1

Specify color. \$1.25

JUMPER, XL-1 MINI HOOK TO STACKING BANANA PLUG

Order No.	Length	Price
201XL-1	32"	\$1.95

Specify color.

AUDIO POWER AMPLIFIERS

5.5 WATT AN315

Designed for mobile radios, tape players, etc. Easy to use. High Gain — 53 dB (Closed Circuit). **\$3.90 ea.**

SPECIAL
FAIRCHILD
LM741PC

3 for \$1.00

INTERISL 8038
PRECISION WAVEFORM
GENERATOR AND VCO

For simultaneous sine, square and triangular waveforms <0.01 Hz to 1 MHz.

PART NO. 8038CCPD \$4.20

Miniature
Toggle Switches

7101	29
7103 (CENTER OFF)	1.94
DOUBLE POLE DOUBLE THROW	
7201	2.24
7203 (CENTER OFF)	2.56

PLESSEY SAMPLER

300 METALIZED CAPACITORS 18 DIFFERENT VALUES	\$26.00
--	---------

TO-220 VOLTAGE
REGULATOR FROM
FAIRCHILD

7805C 5V	7815C 15V
7806C 6V	7818C 18V
7812C 12V	7824C 24V

2 for \$1.20

RESISTOR ASSORTMENTS

Each assortment contains 5 pcs each of 10 different values. Values included are shown in (Ohms)

1/4W 5% (50 pcs total) ... \$1.75 / 1/2W 5% (50 pcs total) ... \$1.85

Ass't. 1: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56 ohm

Ass't. 2: 68, 82, 100, 120, 150, 180, 220, 270, 330, 390 ohm

Ass't. 3: 470, 560, 680, 820 ohm, 1K, 1.2K, 1.5K, 1.8K, 2.2K, 2.7K

Ass't. 4: 3.3K, 3.9K, 4.7K, 5.6K, 6.8K, 8.2K, 10K, 12K, 15K, 18K

Ass't. 5: 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K

Ass't. 6: 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K

Ass't. 7: 1M, 1.2M, 1.5M, 1.8M, 2.2M, 2.7M, 3.3M, 3.9M, 4.7M, 5.6M, (1/2W Assortment No. 7 doesn't include 5.6M)

Ass't. 8 (All seven assortments above)

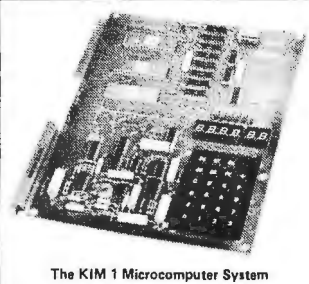
1/4W 5% 350 pcs total \$10.95 1/2W 5% 350 pcs total \$11.55

Sanken
HYBRID
AUDIO
POWER
AMPLIFIERS

SANKEN Series SI-1000G amplifiers are self-contained power hybrid amplifiers designed for Hi-Fi, stereo, musical instruments, public address systems and other audio applications. The amplifiers have quasi-complementary class B output. The circuit employs flip-chip transistors with high reliability and passivated chip power transistors with excellent secondary breakdown strength. Built-in current limiting is provided for SI-1050G and all devices can be operated from a single or split power supply.

SI-1010G (10W output) ... \$ 6.90
SI-1020G (20W output) ... \$13.95
SI-1030G (30W output) ... \$19.00
SI-1050G (50W output) ... \$27.80

Data Sheet Application Notes — \$0.50



The KIM 1 Microcomputer System

The KIM Family	\$245.00	Microcomputer
KIM 2	179.00	4K Static Memory Module
KIM 3	269.00	8K Static Memory Module
KIM 4	119.00	Motherboard
KIM 6	80.00	ROM Expansion
KIMROM-1	150.00	Editor/Assembler
KIMROM-2	50.00	KIMATH
KIM Documentation	\$ 9.95*	KIM 1 User Manual
	9.95*	Programming Manual
	9.95*	Hardware Manual
	9.95*	KIM Math Subroutines
	4.95	Cross Assembler
	4.95	Terminal Interface Monitor
	9.95	KIM Assembler Manual
	9.95	KIM Text Editor

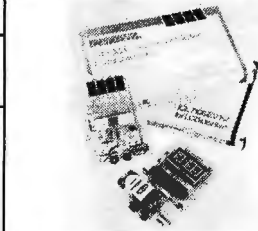
*Included with individual KIM 1 purchase, at no charge.

SOCKET FOR SANKEN AUDIO AMPLIFIERS.	SI-1010G SI-1020G SI-1030G SI-1040G	\$5.95 ea \$9.95 ea
---	--	------------------------

NEW FROM FLUKE - MODEL 8020A
THE DMM FOR THE PROFESSIONAL

- 200 Hr Battery Life
- 26 Ranges for 7 Functions
- 2000 Count Resolution
- High-Low Power Ohms
- Autozero and Auto-polarity
- MOV-protected to 6000V against hidden transients and overload protection to 300 V AC
- Diode Test Function
- Conductance Function checks leakage resistance to 10,000 meg ohms
- Size: HWL (7.1x3.4x1.8 IN) (18.0x8.6x4.5 cm)
- Weight: 13 oz.

ONLY \$169.00

BUILD A WORKING DPM IN 1/2
HOUR WITH THESE COMPLETE
EVALUATION KITS.

Test these new parts for yourself with Intersil's low-cost prototyping kits, complete with A/D converter and LCD display (for the 7106) or LED display (for the 7107). Kits provide all materials, including PC board, for a functioning panel meter.

ICL7106EV (LCD)	\$29.95
ICL7107EV (LED)	\$24.95

RCA COSMAC
MICROPROCESSOR IC
CDP1802CD
4-6 Volt

\$19.95

CAPACITORS

50V CERAMIC DISC \$1.00 Per Package	5pf 9/pkg	300pf 7/pkg	.0047mfd 9/pkg
15pf 9/pkg	330pf 7/pkg	.005mfd 9/pkg	
25pf 9/pkg	390pf 7/pkg	.01mfd 9/pkg	
27pf 9/pkg	470pf 7/pkg	.015mfd 8/pkg	
47pf 8/pkg	560pf 7/pkg	.022mfd 8/pkg	
68pf 8/pkg	680pf 7/pkg	.022mfd 8/pkg	
100pf 8/pkg	.001mfd 9/pkg	.03mfd 8/pkg	
150pf 8/pkg	.0015mfd 9/pkg	.039mfd 7/pkg	
220pf 8/pkg	.0022mfd 9/pkg	.047mfd 7/pkg	
270pf 7/pkg	.003mfd 9/pkg	.1mfd 6/pkg	

PLESSEY POLYESTER MINI BOX

MF V \$	MF V \$	MF V \$	MF V \$
.001 1000 14 .012 630 .14 .15 100 .20			
.0012 1000 14 .015 400 .15 .18 100 .21			
.0015 1000 14 .018 400 .15 .22 100 .23			
.0018 1000 14 .022 400 .15 .27 100 .26			
.0022 1000 14 .027 400 .15 .33 100 .26			
.0027 1000 14 .033 250 .15 .39 100 .33			
.0033 1000 14 .039 250 .15 .47 100 .36			
.0039 630 14 .047 250 .15 .56 100 .44			
.0047 630 14 .056 250 .15 .68 100 .47			
.0056 630 14 .068 250 .15 .82 100 .54			
.0068 630 14 .082 250 .17 1.0 100 .60			
.0082 630 14 1.0 100 .17			
.01 630 14 .12 100 .18			

MATSUO DIPPED TANTALUM

MF V \$	MF V \$	MF V \$	MF V \$
1 35 33 2.2 20 .33 10.0 35 .90			
.15 35 33 2.2 35 .40 16.0 20 .45			
.22 35 33 3.3 35 .42 15.0 35 1.32			
.33 35 33 4.7 35 .45 22.0 16 .45			
.47 35 33 6.8 16 .40 33.0 20 1.32			
.68 35 33 6.8 35 .45 47.0 20 1.53			
1.0 35 33 10.0 16 .42 68.0 16 1.62			
1.5 35 33 10.0 25 .45			

ALUMINUM ELECTROLYTIC (RADIAL LEAD)

MF V \$	MF V \$	MF V \$	MF V \$	MF V \$	MF V \$
1 10 12 10 25 18 33 25 22 100 35 30 330 55					
1 18 12 10 25 18 33 25 24 100 35 33 470 10 35					
1 25 14 10 35 22 33 30 22 10 20 470 16 40					
1 33 10 10 35 22 33 30 10 20 25 470 25 45					
1 50 18 22 10 15 47 10 22 25 25 470 35 60					
5 10 12 22 16 18 47 25 24 25 470 40 80					
5 18 14 22 25 21 47 30 25 25 470 50 100					
6 25 17 25 25 23 47 30 30 30 10 30 100 50 80					
8 35 20 22 10 20 10 10 10 30 35 13 1000 50 120					
5 50 24 32 10 18 100 10 330 35 40 2200 15 130					
10 14 33 17 10 25 25 25 25 35 45 2200 35 160					
					2200 50 250

MAIL ORDER ADDRESS — P.O. Box 2028P, Culver City, CA 90230. Send check or money order, COD, Master Charge and BankAmericard welcomed. Minimum Order: \$10.00. Add \$1.00 to cover postage and handling. California residents add 6% sales tax.

TELEPHONE ORDERS: Call (213) 641-4064.

ANCRONA STORES DO NOT ACCEPT MAIL OR TELEPHONE ORDERS

CALIFORNIA
ANCRONA

11080 Jefferson Blvd.
Culver City, CA 90230
(213) 390-3595

CALIFORNIA
ANCRONA

1300 E. Edinger Ave.
Santa Ana, CA 92705
(714) 547-8424

ARIZONA
ANCRONA

4518 E. Broadway
Tucson, AZ 85711
(602) 881-2348

OREGON
ANCRONA

1125 N.E. 82nd Ave.
Portland, OR 97220
(503) 254-5541

GEORGIA
ANCRONA

3330 Piedmont Rd., NE
Atlanta, GA 30305
(404) 261-7100

TEXAS
ANCRONA

2649 Richmond
Houston, TX 77098
(713) 629-3489

CANADA, B.C.
ANCRONA

5656 Fraser St.
Vancouver, B.C.
V5W 2V4
(604) 324-0707

EDMUND SCIENTIFIC

HOLIDAY VALUES

NEW WIDE FIELD TELESCOPE



Astroscan lets you enjoy clear, bright, wide-angle views of stars, moon, comets, etc. Completely portable, this unique 4 1/4", f/4 Newtonian reflector houses top quality optics. Designed for ease of handling and use, Astroscan weighs only 10 lbs. and stands 17" high. What an instrument!

No. 2001

\$149.95 Ppd.

50X - 150X - 300X MICROSCOPE

Great for students. Top Quality achromatic obj. lenses make this a superior microscope for beginners. Rack & pinion focusing, revolving 3-objective turret, sturdy metal construction. Wooden case. 10" high.

No. 70,008

Only **\$39.95** Ppd.



ENVIRONMENTS

• Strange, beautiful records that can help you think.

Scientifically designed to help you study, read, meditate, romance or eliminate unwanted noise, these long-playing 33 1/3 rpm records provide a unique tranquil experience. Each provides one hour of naturally occurring sounds that range from soothing surf to thunderstorm.

A) Seashore/Aviary — surf on one side, melodic birds on other. No. 72,156

B) Thunderstorm/Rain in Forest — beautifully realistic rainfall. No. 72,157

\$7.25 ea. Ppd.

Free Catalog

EDMUND ECONOMY WEATHER STATION

• Learn Weather Forecasting

Kit lets you build a complete weather station. Learn how instruments work and how they predict weather. Incl. anemometer, windvane, electronic wind speed/direction indicator, air-tank barometer, sling psychrometer, rain gauge, cloud chart, wire, forecasting manual. Great for science projects.

No. 71,022

\$23.50



Free Catalog

BUILD A MINIATURE WORKING CLOCK

Everything you need to build these fine wooden clocks. Each contains a pre-assembled movement from Germany's Black Forest.

(A) Grandfather Clock
(7x1 1/4x1 1/2")

No. 72,225 .. **\$10.00** Ppd.

(B) Wall Clock
(8 1/2x3 1/2x1 3/4")

No. 72,226 .. **\$10.00** Ppd.



SENSITIVE TR METAL DETECTOR



Fully transistorized transmitter/receiver (TR) detector with sensitivity rivaling models twice the price. Built of rugged aluminum with a waterproof search coil. Detects a penny at 5". Wt. 2 lb. 6 oz.

No. 80,262 **\$39.95** Ppd.

SUPER QUALITY 10X MAGNIFIER



This Hastings triplet is possibly the most favored pocket magnifier today. Full 10X, color-corrected, flat-field, cemented lens system. Great for jewelers, collectors, engravers, hobbyists, etc. Mtd. in aluminum cell; chrome-plate case. 3/4" x 1 1/4" closed; clear lens dia. 1/2".

No. 30,344

\$12.95 Ppd.

**Send for your FREE
164 page Edmund
Scientific Catalog
with over 4000 bargains**



GIANT MAGNET, LITTLE PRICE!

Tie a line to our over-150 lb.-lift ceramic magnet and haul up treasure from the sea. 4 ceramic magnets, in series, between steel plates. A 1-lb. "giant"!

No. 42,318
(1x1 1/4x4 3/4") ...

\$11.95 Ppd.



**ORDER
FREE CATALOG
HERE**

**TO ORDER PRODUCTS
USE THIS COUPON**

EDMUND SCIENTIFIC CO.
Dept. AV22, Edscorp Bldg.
Barrington, New Jersey 08007

**Send GIANT 164 Page Catalog
packed with unusual bargains.**

Name _____
Address _____
City _____
State _____ Zip _____

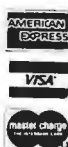
EDMUND SCIENTIFIC CO.
Dept. AV21, Edscorp Bldg.
Barrington, N.J. 08007

Charge My ☐ Amer. Exp. ☐ BAC (VISA) ☐ MC

Interbank # _____ Acct. # _____

Card # _____ Exp. Date _____

Sig. _____



30 DAY GUARANTEE

You must be completely satisfied with any Edmund item or return it within 30 days for a full refund.

Name _____
Address _____
City _____ State _____ Zip _____

☐ Please send me the following items I have indicated below:

Stock No.	Qty.	Price
Handling		\$1.00

FREE INFORMATION:

Learning more about a product that's advertised or mentioned in an article in this month's issue is as simple as one, two, three. And absolutely free.

1 Print or type your name and address on the attached card. Use only one card per person.

2 Circle the number(s) on the card that correspond to the number(s) at the bottom of the advertisement or article for which you want more information. (Key numbers for advertised products also appear in the Advertisers' Index.)

3 Simply mail the card, and the literature will be mailed to you free of charge from the manufacturer.

FREE INFORMATION:

This address is for our product Free Information Service only. Editorial inquiries should be directed to POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

USE ONLY ONE CARD PER PERSON

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

(Zip Code must be included to insure delivery.) (Void after Jan. 31, 1978)

Do you own any of the following?

- a. ☐ CB Base station b. ☐ CB Mobile unit g. ☐ None of the above
c. ☐ Ham equipment d. ☐ SWL Receiver
e. ☐ Scanner f. ☐ Monitor Receiver

☐ Please send me 12 issues of Popular Electronics for \$6.99 and bill me.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120

POPULAR ELECTRONICS

PE11772

USE ONLY ONE CARD PER PERSON

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

(Zip Code must be included to insure delivery.) (Void after Jan. 31, 1978)

Do you own any of the following?

- a. ☐ CB Base station b. ☐ CB Mobile unit g. ☐ None of the above
c. ☐ Ham equipment d. ☐ SWL Receiver
e. ☐ Scanner f. ☐ Monitor Receiver

☐ Please send me 12 issues of Popular Electronics for \$6.99 and bill me.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120

POPULAR ELECTRONICS

PE11771

USE ONLY ONE CARD PER PERSON

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

(Zip Code must be included to insure delivery.) (Void after Jan. 31, 1978)

Do you own any of the following?

- a. ☐ CB Base station b. ☐ CB Mobile unit g. ☐ None of the above
c. ☐ Ham equipment d. ☐ SWL Receiver
e. ☐ Scanner f. ☐ Monitor Receiver

☐ Please send me 12 issues of Popular Electronics for \$6.99 and bill me.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120

First Class
Permit No. 217
Clinton, Iowa

BUSINESS REPLY MAIL

No postage necessary if mailed in the United States

POSTAGE WILL BE PAID BY

Popular Electronics

P.O. Box 2905
Clinton, Iowa 52732



First Class
Permit No. 217
Clinton, Iowa

BUSINESS REPLY MAIL

No postage necessary if mailed in the United States

POSTAGE WILL BE PAID BY

Popular Electronics

P.O. Box 2905
Clinton, Iowa 52732



First Class
Permit No. 217
Clinton, Iowa

BUSINESS REPLY MAIL

No postage necessary if mailed in the United States

POSTAGE WILL BE PAID BY

Popular Electronics

P.O. Box 2905
Clinton, Iowa 52732



The Most Spectacular Sound Exhibition of STEREO FIDELITY Ever Available on Disc and Cassette



This record (and cassette) is the result of 2 years of intensive research in the sound libraries of Deutsche Grammophon Gesellschaft, Connoisseur Society Westminster Recording Company and Cambridge Records, Inc. The Editors of Stereo Review have selected and edited those excerpts that best demonstrate each of the many aspects of the stereo reproduction of music. The record and cassette offer you a greater variety of sound than has ever before been included on a single disc or tape. It is a series of independent demonstrations, each designed to show off one or more aspects of musical sound and its reproduction. Entirely music, the record and cassette have both been edited to provide self-sufficient capsule presentations of an enormous variety of music arranged in a contrasting and pleasing order. It includes all the basic musical and acoustical sounds that you hear when you listen to records and tapes, isolated and pointed up to give you a basis for future critical listening.

WIDE RANGE OF DEMONSTRATIONS

• Techniques of Separation • Multiple Sound Sources • Acoustic Depth • Ambiance of Concert Hall • Sharp Contrasts of Dynamics • Crescendo & Diminuendo • Very High & Very Low Pitched Musical Sounds • Polyphony (2 or more melodies at once) With Both Similar & Contrasting Instruments • Tonal Qualities of Wind, String & Percussion Instruments • Sounds of Ancient Instruments • Sounds of Oriental Instruments • Sound of Singing Voice, Both Classically Trained and Untrained • Plus a Large Sampling of Finger Snapping, Hand Clapping, Foot Stamping & Other Musical & Percussive Sounds.

13 SUPERB SELECTIONS

STRAUSS: Festive Prelude, Op. 61 (excerpt) DGG.
DEBUSSY: Feux d'artifice (excerpt) Connoisseur Society.
BEETHOVEN: Wellington's Victory (Battle Symphony) (excerpt from the first movement) Westminster Records.
MASSAINGO: Canzona XXV & 16 (complete) DGG Archive.
CORRETT: Concerto Comique Op. 8, No. 6, "Le Plaisir des Dames" (third movement) Connoisseur Society.
KHAN: Raga Chandranandan (excerpt) Connoisseur Society.
RODRIGO: Concert-Serenade for Harp and Orchestra (excerpt from the first movement) DGG.
MANITAS DE PLATA: Gypsy Rumba (complete) Conn. Soc.
MARCELLO: (arr. King) Psalm XVII "The Heavens are Telling" (complete) Connoisseur Society.
PRAETORIUS: Terpsichore: La Bourrée XXXII (complete) DGG Archive.
BERG: Wozzeck (excerpt from Act III) DGG.
BARTOK: Sonata for two pianos and Percussion (excerpt from the first movement) Cambridge Records.
BEETHOVEN: Wellington's Victory (Battle Victory) (excerpt from the last movement) Westminster.

FREE—Booklet which discusses and describes each of the selections performed.

HERE'S HOW TO ORDER

CASH: Mail your order along with your name, address and remittance in the amount of \$6.95 for the record; \$7.95 for the cassette. Residents of CA, CO, FL, IL, MI, MO, NY STATE, DC and TX add applicable sales tax.

CHARGE: To your American Express, BankAmericard, Master Charge or Diners Club account! Mail your order, name, address, credit card # and expiration date (Master Charge customers include 4-digit Interbank # above your name). Be sure your signature is on your order. You will be billed as indicated above.

OUTSIDE U.S.A. RECORD AND CASSETTE ARE \$8.95 EACH.

ORDER FROM: DEMONSTRATION RECORD, CONSUMER SERVICE DIVISION, 595 BROADWAY, NEW YORK, N. Y. 10012.

GOOD NEW 3

BARGAINS OF THE MONTH

RCA High quality "POCKET" VOM

• 1000 ohms per volt
Model WV-539A. Features 1% precision, movements diode protected against burnout. Measures DC volts 0-15-150-1000; AC volts 0-15-150-1000; DC current 0-150ma; resistance X1000. Sensitivity 1000 ohms/volt AC-DC. Uses penlite cell, not included. Size 2 3/4 x 3 1/2 x 1 3/4". Wt. 5 ozs. Cat. No. 11E3921

\$8.88

\$5.50 TV GAME & HI-FI JOY STICK

• Includes four 100K pots
For TV & computer games, and quadrophonic balancing! 1 1/2 x 1 1/2 x 1". With 1" handle. Wt. 6 ozs. Cat. No. 11E3808

POLY PAKS "CHIPS" AWAY IC PRICES!

Order Cat. No. 11E4048 and Type No.

Type	Stopwatch	Sale
ICM7205	Six TV Game	14.95
AY3-8500-1	4 1/2 Digit DVM	9.95
MMS5330	Volt Control Osc.	4.95
8038C	Encoder ROM BCD	4.95
KR2376	350 MHz Prescaler	6.95
95H90DC	Touch Tone Encoder	8.95
MC14410	Char. Gen. (2513 equl)	3.95
MK2002P	3 1/2 Digit DPM	12.50
7207A/7208	Alarm Clock	2.95
ICM7107	Microprocessor	14.95
MMS5316	1702A PROM	22.88
8080A	8K EPROM	22.88
1702A	1K RAM	1.39
2708		
2102-1		

DIP Reg. \$1.69 ea. Switches Your Choice!

Cat. No.	Switches	Price
11E3668	2	\$1.00
11E3669	3	\$1.00
11E3670	4	\$1.00
11E3671	5	\$1.00
11E3672	6	\$1.00
11E3673	7	\$1.00
11E3674	8	\$1.00
11E3675	9	\$1.00
11E3676	10	\$1.00
11E3677	11	\$1.00
11E3678	12	\$1.00
11E3679	13	\$1.00
11E3680	14	\$1.00
11E3681	15	\$1.00
11E3682	16	\$1.00
11E3683	17	\$1.00
11E3684	18	\$1.00
11E3685	19	\$1.00
11E3686	20	\$1.00
11E3687	21	\$1.00
11E3688	22	\$1.00
11E3689	23	\$1.00
11E3690	24	\$1.00
11E3691	25	\$1.00
11E3692	26	\$1.00
11E3693	27	\$1.00
11E3694	28	\$1.00
11E3695	29	\$1.00
11E3696	30	\$1.00
11E3697	31	\$1.00
11E3698	32	\$1.00
11E3699	33	\$1.00
11E3700	34	\$1.00
11E3701	35	\$1.00
11E3702	36	\$1.00
11E3703	37	\$1.00
11E3704	38	\$1.00
11E3705	39	\$1.00
11E3706	40	\$1.00
11E3707	41	\$1.00
11E3708	42	\$1.00
11E3709	43	\$1.00
11E3710	44	\$1.00
11E3711	45	\$1.00
11E3712	46	\$1.00
11E3713	47	\$1.00
11E3714	48	\$1.00
11E3715	49	\$1.00
11E3716	50	\$1.00
11E3717	51	\$1.00
11E3718	52	\$1.00
11E3719	53	\$1.00
11E3720	54	\$1.00
11E3721	55	\$1.00
11E3722	56	\$1.00
11E3723	57	\$1.00
11E3724	58	\$1.00
11E3725	59	\$1.00
11E3726	60	\$1.00
11E3727	61	\$1.00
11E3728	62	\$1.00
11E3729	63	\$1.00
11E3730	64	\$1.00
11E3731	65	\$1.00
11E3732	66	\$1.00
11E3733	67	\$1.00
11E3734	68	\$1.00
11E3735	69	\$1.00
11E3736	70	\$1.00
11E3737	71	\$1.00
11E3738	72	\$1.00
11E3739	73	\$1.00
11E3740	74	\$1.00
11E3741	75	\$1.00
11E3742	76	\$1.00
11E3743	77	\$1.00
11E3744	78	\$1.00
11E3745	79	\$1.00
11E3746	80	\$1.00
11E3747	81	\$1.00
11E3748	82	\$1.00
11E3749	83	\$1.00
11E3750	84	\$1.00
11E3751	85	\$1.00
11E3752	86	\$1.00
11E3753	87	\$1.00
11E3754	88	\$1.00
11E3755	89	\$1.00
11E3756	90	\$1.00
11E3757	91	\$1.00
11E3758	92	\$1.00
11E3759	93	\$1.00
11E3760	94	\$1.00
11E3761	95	\$1.00
11E3762	96	\$1.00
11E3763	97	\$1.00
11E3764	98	\$1.00
11E3765	99	\$1.00
11E3766	100	\$1.00

TRAVELS FAST!

3 1/2 DIGIT OPEN FACE DPM

• Dual Range! 0-2V, 0-200mV DIGITAL PANEL METER

Kit LOWEST PRICE ANYWHERE... others have 'em at \$49.95. Displays 3 1/2 digits, at 0.05% accuracy! Minus sign automatically displays negative input. High input impedance, 100 megohms. Uses the latest MOS-LSI circuitry, (7107), assemblies in minutes. Automatic zeroing. Voltage range selectable by changing two components (both sets supplied). Complete kit with PC board, readouts, IC, & all other components. Less case. Requires 25VDC. Size 3 1/2" x 5".

Cat. No. 11E4042 DPM Kit Wt. 14 ozs. \$29.95

Cat. No. 11E4042 DPM W/Case \$39.95

Cat. No. 11E4038 7107 Chip \$15.95

0.4" LED Digits!

\$29.95

TOUCH-TONE ENCODER KIT \$22.50

Buy 'em separately

11E3382 Touch Tone IC MC14410P \$6.95

11E3149 12-Key "feather touch Keyboard 6.88

11E3635 1.00 MHz Crystal \$5.95

11E3383 Autotouch PC Board \$2.95

Attention! 2 meter FM HAM! Phone from your mobile or portable rig. Kit includes: Chomeric touch tone mod, Motorola MC14410 chip, & all components necessary, with PC board, 1 mhz crystal, Wt. 8 ozs. Cat. No. 993385

J. C. PENNEY'S 8-Track TAPE TRANSPORT \$12.95

69c EACH 6 for \$2.50

3/4" square. Screwdriver shaft. 20% tolerance. 1/2 watt. German construction. FC leads. Order by Cat. No. and Value. *Available in all types. **Available in Cat. No. 9A3863 only

"CB" POWER SUPPLY \$16.88

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

12 VDC @ 3 Amps output

Regulated, continuous duty

Completely wired

POLY PAKS® IS THE WORLD'S LARGEST ELECTRONIC SUPERMARKET DISCOUNT

NOV. 77 POP ELECTRONICS SPECIALS

ECC INDUSTRIAL SPEED CONTROL

3 for \$5.95

\$16. □

A \$80 item. Rated at 1200 watts. A very elaborate circuit for controlling many electrical and electronic devices. Easily controls speeds of electric drills, brush type motors, etc. Built with heavy duty aluminum framing. Complete with external pot, for variable speed control. Heavy duty colored wires for 115VAC 60 cycles, and item to be controlled. 10/32 mounting stud. Outperforms our previous sell-out. With hookup diagram. Use as temperature controller too. Wt. 2 lbs. Cat. No. 11E3892

Cat. No. 11E4011 \$5.95

5 GIGAHERTZ

MICROWAVE POWER TRANSISTOR

HAMS take note! High frequency, high power NPN, stud mount TO-18 case. Perfect for UHF and microwave communications gear. 3/4" dia. epoxy case, 1/2" gold plated leads, and 1/2" stud for heat sinking. Bveco 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Great for Light Shows, Strobes, Light Displays, Slide Projector!

Worth many times our asking price.

Wide angle focusing lens!

5 IN 1 PROJECT-ALL SLIDE PROJECTORS \$12.50

U.S. maker. Originally designed as a slide projector. Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-200, ic max 300 mls. power dissipation 5 watts. Two emitter leads. Type SD1043. Wt. 2 ozs.

Some may be modified for projecting a bar of life. High quality 3 lens condensing system. Requires standard 310V type 20-20



SD SALES COMPANY

P.O. BOX 28810-D

DALLAS, TEXAS 75228

NOW - THE ULTIMATE RAM BOARD 32K FOR \$427.

Memory Capacity
Memory Addressing
Memory Write Protection

8K, 16K, 24K, 32K USING MOSTEK MK4115 WITH 8K BOUNDARIES & PROTECTION.

Utilizes DIP switches.

PC board comes with sockets for 32K operation THE ABOVE NOW AVAILABLE

BUY AN \$100 COMPATIBLE 8K RAM BOARD AND UPGRADE THE SAME BOARD TO A MAXIMUM OF 32K* IN STEPS OF 8K AT YOUR OPTION BY MERELY PURCHASING MORE RAM CHIPS FROM S.D. SALES! AT A GUARANTEED PRICE—LOOK AT THE FEATURES WE HAVE BUILT INTO THE BOARD.

PRICES START AT \$139.00 FOR 8K RAM KIT.
ADD \$96.00 FOR EACH ADDITIONAL 8K RAM DESIRED

Board fully assembled and tested for \$50.00 extra.

8K FOR \$139.

Interface Capability

CONTROL, DATA AND ADDRESS INPUTS
UTILIZE LOW POWER SCHOTTKY DEVICES.

Power Requirements

+8VDC 400 MA DC
+18VDC 400MA DC
-18VDC 30MA DC

on board regulation is provided.

ON BOARD (INVISIBLE) REFRESH IS PROVIDED WITH NO WAIT STATES OR CYCLE STEALING REQUIRED.

MEMORY ACCESS TIME IS 375ns.
Memory Cycle Time is 500ns.

*AVAILABLE THE 1st QUARTER OF 1978:
16K, 32K, 48K, 64K USING MOSTEK 4116 WITH 16K BOUNDARIES & PROTECTION.

NEW PRICE!

Z-80 CPU BOARD KIT

Complete Kit

\$139.

CHECK THE ADVANCED FEATURES OF OUR Z-80 CPU BOARD:
Expanded set of 158 instructions, 8080A software capability, operation from a single 5VDC power supply, always stops on an M1 state, true sync generated on card (a real Plus feature), dynamic refresh and NMI available, either 2MHz or 4MHz operation, quality double sided plated through PC board, standard kit shipped with Z-80 technical manual and all parts plus sockets provided for all IC's. Z-80 Chip & Manual Sep. — 39.95
*Add \$10.00 extra for Z-80A chip which allows 4MHz operation.

NEW PRICE!
NEW PRICE!

ALL OF ABOVE ARE \$100, IMSAI & ALTAIR 'A' COMPATIBLE.

We can supply modifications needed for many other systems!

4K LOW POWER RAM

Fully Buffered — on board regulated — reduced power consumption utilizing low power 21L02—1500ns RAMS — Sockets provided for all IC's. Quality plated through PC board.
*Add \$10.00 for 250ns RAM operation.

The Whole Works - \$79.95

NEW PRICE!

SIX DIGIT ALARM CLOCK KIT

FEATURES: Litronix dual 1/2" displays, Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). P.C. Board and Xfmr optional. Eliminate the hassle — avoid the 5314! Do not confuse with Non-Alarm kits sold by our competition!

P.C.B. — \$3.00; AC XFMR — \$1.50 **\$9.95 KIT**

MUSICAL HORN

ONE TUNE SUPPLIED WITH EACH KIT. ADDITIONAL TUNES — \$6.95 EACH. SPECIAL TUNES AVAILABLE — YOU SUPPLY THE SHEET MUSIC WE SUPPLY PROGRAMMED PROM TO YOU. STANDARD TUNES NOW AVAILABLE:
— DIXIE — EYES OF TEXAS — ON WISCONSIN — YANKEE DOODLE DANDY — NOTRE DAME FIGHT SONG — PINK PANTHER — AGGIE WAR SONG — ANCHORS AWAY — NEVER ON SUNDAY — BRIDGE OVER RIVER KWAI — CAR & BOAT KIT HOME KIT

\$34.95 \$26.90

JUMBO LED CLOCK KIT

FEATURES:

- A. Bowmar Jumbo .5 inch LED array.
- B. MOSTEK — 50250 — Super Clock Chip
- C. On board precision crystal time base.
- D. 12 or 24 hour Real Time Format.
- E. Perfect for cars, boats, vans, etc.
- F. P.C. Board and all parts (less case) included.

GOOD VALUE!

Alarm option — \$1.50

AC XFMR — \$1.50

\$16.95 KIT

RAM'S

CPU'S

PROM'S

21L02 — 500 NS. 8/15.50
21L02 — 250 NS. 8/15.95
2114 — 4K 14.95
1101A — 256 8/4.00
1103 — 1K99

Z-80 includes manual. 39.95
Z-80A includes manual 44.95
8080A CPU 8 BIT 11.95
8008 CPU 8 BIT 6.95

1702A — 1K — 1.5us 3.95 or 10/35.00
2708 — 8K Intel — 450ns 14.95
5204 — 4K 7.95
82S129 — 1K 2.50
2708S — 8K signetics 650ns 9.95

CESSOR CHIPS—MICROPROCESSOR CHIPS—MICROPROCESSOR CHIPS—MICROPROCE

8212 — I/O PORT 3.50
8214 — P.I.C. 12.95
8216 — NON INVERT BUS 4.95
8224 — CLOCK GEN. 4.95
8226 — INVERT BUS. 3.95
PIO for Z-80 14.95
CTC for Z-80. 14.95

8228 SYS CONTROLLER 8.20
8251 PROG. COMM. INTERFACE. 10.95
8255 PROG. PERP. INTERFACE. 13.50
8820 DUAL LINE RECR 1.75
8830 DUAL LINE DR 1.75

2513 CHAR. GEN. 7.50
8838 QUAD BUS. RECR 2.00
74LS138N — 1/8 DECODER99
8T97 — HEX TRI STATE BUFFER 1.25
1488/1489 — RS232. 1.50
TR1602B UART 3.95

ENTER CHIPS—COUNTER CHIPS—COUNTER CHIPS—COUNTER CHIPS—COUNTER CHI

MK50397 6 digit elapsed timer 8.95
MK50250 Alarm Clock 4.99

MK50380 Alarm chip 2.95
MK50396 - 6 digit up/down counter. 12.95

MK5002 - 4 digit counter 8.95
MK5021 - Cal. Chip w/sq. rt 2.50

ITT DUAL SENSE AMPLIFIER.
75234 AND 75235. 49c each

SPRAGUE DUAL DIFFERENTIAL
AMP. TD101 49c each

GENERAL INSTRUMENT DIODE.
1N82AG 19c each

FLAT PACK 5400 SERIES.
SPECIAL BUY FROM ITT.
20 Assorted Devices for \$1.00

DISC CAP ASST.
P.C. leads. At least
10 different values.
Includes .001, .01,
.05 & other stan-
dard values.
60/\$1.

39 MFD
16V Mallory
Electrolytic
15/\$1.
THERMISTORS
MEPCO — NEW!
1.5K OHM
5/\$1.00

RESISTOR
ASSORTMENT
PC leads
A good mix
of values.
SPECIAL!
200/\$2.

1000 MFD
FILTER CAPS
Rated 35 WVDC.
Upright style with
PC leads. Many
popular values.
4/\$1.00

7500 Mallory
30WVDC
Computer
Grade Caps
\$3.00 each

POWER
RESISTOR
15 OHM
25W by
CLAROSTAT
75¢ ea.

IC's from XEROX
IC's Removed from PC boards. All tested; full spec.
7400 — 9c 7430 — 9c 7493 — 26c
7402 — 9c 7440 — 9c 74121 — 22c
7404 — 9c 7437 — 10c 74123 — 32c
7410 — 9c 7438 — 10c 74155 — 22c
7416 — 13c 7451 — 9c 74193 — 35c
7420 — 9c 7474 — 16c 8233 — 35c
1402A — 50c 7475 — 24c Intel 1302
45c
GREAT BUY!! LIMITED QUANTITY!

ITT Part # SAJ 101
IDEAL FOR ELECTRONIC
MUSIC CIRCUITS — 7 STAGE
FREQ. DIVIDERS.
49¢ ea.

MICRO-DIP by EECO \$1.95
NEW SERIES 23001
WORLD'S SMALLEST BCD CODED DIP SWITCH!
P.C. Mount! 2300—02G—1248; 2300—12G—1248 compliment

JOY STICKS
4—100K
POTS
\$3.95 ea.

IC SOCKETS
14 pin - 5/\$1.00
16 pin - 5/\$1.25
28 pin - 3/\$1.00

Slide Switch Asst.
Our best seller. In-
cludes miniature &
standard values.
12/1.00

P.C. LEAD
DIODES
1N4148/1N914
100/\$2.

TRIM POTS
10K, 20K,
25K
10/\$1.00

1N4002
1A
100 PIV
40/\$1.

CALL IN YOUR BANKAMER-
ICARD (VISA) OR MASTER
CHARGE ORDER IN OUR
CONTINENTAL TOLL FREE
WATTS LINE:

Texas Residents Call Collect:
214/271-0022
1-800-527-3460
DEALER INQUIRIES INVITED!

Terms - 60 Day
Money Back Guarantee!

NO COD'S. TEXAS RESIDENTS ADD
5% SALES TAX. ADD 5% OF ORDER
FOR POSTAGE & HANDLING. OR-
DERS UNDER \$10. ADD 75c HAND-
LING. FOREIGN ORDERS — U. S.
FUNDS ONLY!

Orders over \$15. - Choose \$1. FREE MERCHANDISE!



Radio Hut

Money back guarantee. NO COD'S. Texas residents add 5% sales tax. Add 5% of order for postage and handling. Orders under \$15.00 add 75 cents. Foreign orders add 10% for postage.

For your convenience, call your BankAmericard or Master Charge orders in on our Toll Free Watts Line: 1-800-527-2304. Texas residents call collect:

1-214-271-8423.

P.O. Box 38323P

Dallas, Texas 75238

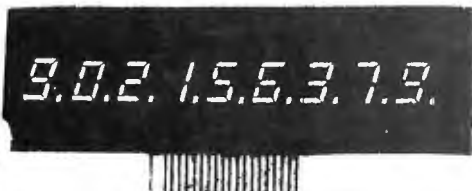
PLASMA DISPLAY KIT

Kit includes:

- 12 digit display with .4" characters
 - Power transformer
 - Drilled PC Board
 - Thirty minute assembly
- Line cord NOT included.

THOUSANDS
IN STOCK!

ONLY
\$3.95



UNSCRAMBLER KIT

- Easily tuned
- Full instructions included
- Drilled fiberglass P.C. Board
- One hour assembly
- Easy to install
- Punched case

Interfaced with any monitor
or scanner
Only

\$19.95

This unit can unscramble any scrambled frequency such as the new Motorola scramble and so on.

SOCKETS

NOW IN STOCK!

- 14 pin low profile .22
- 16 pin low profile .25
- 18 pin low profile .30
- 28 pin low profile .69
- 40 pin low profile .89

LS



74LS00	.21	74LS145	1.00
74LS02	.21	74LS151	.70
74LS03	.21	74LS153	.70
74LS04	.28	74LS155	.69
74LS05	.26	74LS156	.70
74LS08	.21	74LS157	.75
74LS09	.28	74LS158	.71
74LS10	.21	74LS159	.85
74LS11	.21	74LS161	.85
74LS13	.45	74LS162	.85
74LS14	.99	74LS163	.85
74LS15	.26	74LS168	.85
74LS20	.24	74LS169	.85
74LS21	.28	74LS170	1.69
74LS22	.28	74LS173	1.10
74LS26	.32	74LS174	1.00
74LS27	.32	74LS175	.81
74LS30	.26	74LS190	.95
74LS32	.32	74LS191	.95
74LS37	.32	74LS192	.95
74LS38	.32	74LS193	.95
74LS40	.26	74LS194	.95
74LS42	.65	74LS195	.85
74LS51	.26	74LS196	.85
74LS54	.26	74LS197	.85
74LS55	.26	74LS251	.85
74LS53	.35	74LS253	.81
74LS74	.35	74LS257	.71
74LS76	.49	74LS258	.71
74LS86	.36	74LS260	.26
74LS90	.55	74LS266	.26
74LS92	.55	74LS279	.55
74LS93	.55	74LS290	.75
74LS109	.38	74LS293	.81
74LS112	.38	74LS295	.95
74LS113	.38	74LS298	.95
74LS114	.38	74LS305	.55
74LS125	.47	74LS366	.55
74LS126	.47	74LS367	.55
74LS132	.79	74LS368	.55
74LS133	.35	74LS390	1.75
74LS136	.37	74LS393	1.45
74LS138	.71	74LS970	2.30
74LS139	.71		

TTL



7400	.13	7483	.67
7401	.13	7486	.28
7402	.13	7489	1.25
7403	.13	7490	.65
7404	.15	7491	.61
7405	.13	7492	.43
7406	.16	7493	.43
		7494	.67
7408	.19	7495	.67
7409	.19	7496	.67
7410	.13	74100	.28
7411	.18	74107	.28
7413	.37	74121	.29
7420	.13	74123	.48
7421	.13	74125	.37
7423	.25	74141	.75
7425	.29	74145	.85
7426	.24	74151	.61
7427	.19	74153	.61
7437	.23	74154	.98
7438	.23	74157	.63
7440	.13	74161	.86
7442	.47	74163	.85
7443	.59	74164	.85
7444	.59	74174	.91
7447	.68	74175	.85
7448	.71	74180	.67
7450	.13	74181	1.89
7451	.13	74191	.98
7453	.13	74193	.81
7454	.13	74194	.81
7460	.19	74195	.69
7470	.27	74H00	.25
7472	.25	74H05	.25
7473	.29	74H20	.25
7474	.29	74H61	.25
7475	.47	74H73	.25
7476	.31	9316	.85
7480	.31	9601	3/1.00
7482	.57	9L04	.35

ITT MOS TO LED DRIVERS

ITT 501 Quad Seg. Dr.	.35
ITT502 Hex Digit Dr.	.49
ITT503 Quad Seg. Dr.	.49
ITT506 Hex Digit Dr.	.49
ITT508 8 Digit Dr.	.49
ITT509 8 Seg. Dr.	.49
ITT511 Quad Seg. Dr.	.55
ITT514 8 Digit Dr.	.59

We have 100's of thousands of the above listed parts. These parts 100% prime.

NI-CAD BATTERIES

These are brand new nickel cadmium batteries. They are banded together in packs of "4AA". ONLY **\$4.50 pk.**

MK 5005

4-digit counter/latch decoder; 7 segment output only. 24 pin dip with specs. **\$8.00 Each**

SPECIAL DEVICES

L (•) (•) K

82S23	\$2.19
2513	\$10.00
1101A	.75
1103A	\$1.10
8T13	\$1.25
8T97B	\$1.25

CMOS

CD4000	.19	CD4047	1.89
CD4001	.19	CD4048	.49
CD4002	.19	CD4050	.49
CD4006	1.20	CD4051	1.25
CD4007	.19	CD4053	1.25
CD4009	.47	CD4056	1.15
CD4010	.47	CD4066	.78
CD4011	.19	CD4071	.19
CD4012	.19	CD4081	.23
CD4013	.32	CD4507	1.00
CD4014	.78	CD4508	2.80
CD4015	.78	CD4510	1.10
CD4016	.32	CD4512	1.10
CD4017	.95	CD4516	1.10
CD4018	.95	CD4520	1.10
CD4019	.45	CD4528	.87
CD4020	.97	74C02	.25
CD4021	.97	74C04	.32
CD4022	.97	74C107	.79
CD4023	.19		
CD4024	.75		
CD4025	.19		
CD4027	.45		
CD4028	.89		
CD4029	.99		
CD4030	.35		
CD4035	.99		
CD4040	1.00		
CD4041	.69		
CD4042	1.05		
CD4043	.60		
CD4044	.60		
CD4046	1.50		



SAVE

ORDER BY PHONE.

Charge your order to BankAmericard or Master Charge

USE OUR TOLL FREE WATTS

1-800

527-2304



Charge

order
by
phone



TTL SPECIAL

9002/7400	10/1.00
9003/7410	10/1.00
9004/7420	10/1.00
9006/7460	6/1.00
9007/7430	10/1.00
9009/7440	10/1.00
9016/7404	8/1.00
9024/74109	3/1.00
9300/74195	2/1.00
9000 Series parts prime from ITT. Pin for pin compatible with 7400 numbers shown.	

WE WILL NOT BE
UNDER
SOLD!

LT701E CLOCK KIT

KIT INCLUDES:

- POWER TRANSFORMER
- PUNCHED CASE
- SWITCHES
- 12 HOUR OPERATION

Kit Only **\$14.95**

Complete except for line cord.



VARIABLE POWER SUPPLY KIT NO. 1

- Continuously variable from 5V to 20V
- Excellent regulation up to 1/2 Amp
- Kit includes all components
- Drilled fiberglass P.C. Board
- Case Included
- 4400 Mfd of filtering
- One hour assembly

This model will power a 5 watt transistorized CB Radio.

ONLY **\$10.95**

VARIABLE POWER SUPPLY KIT NO. 2

Same as above but with a 1 Amp output, also with case.

Only **\$13.95**

LINEARS

LM301	.30
LM307	.30
LM308	.95
LM309K	1.49
LM311	.85
LM318	1.15
LM377	1.85
LM380	.75
LM3900	.40
LM710	.25
LM711	.25
LM723	.69
LM741	.25
LM748	.25
NE553	1.95
NE555	.40
NE556	.95
NE565	.95
NE567	1.25
1458	.55
75491	.29
75492	.35
3043	.75
8038	3.95

60Hz CRYSTAL TIME BASE

This kit enables a MOS clock circuit to operate from a DC power source. Ideal for car, camper, van, boat, etc. 60Hz output with an accuracy of .005% (typ). Low power consumption 2.5 mA (typ). Small size will fit most any enclosure. Single MOS IC oscillator/divider chip 5-15 volts DC operation.

ONLY **\$5.95 each**

2 **\$10.00**
for BEST SELLER!

THOUSANDS
SOLD!

Come by and visit our retail store in Garland. Located at **3017 Lincoln Court.**

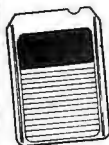
Store Hours:

10-6 p.m. Tue.-Fri.

Sat. 10-3 p.m.

8-TRACK TAPE 40-MINUTE BLANK

Reg. ~~79¢~~



TA-907

49¢

- Designed for Music Reproduction
- Erased Never Used

BATTERY NI-CAD RECHARGEABLE "AA" PEN-LITE CELL



BA-341

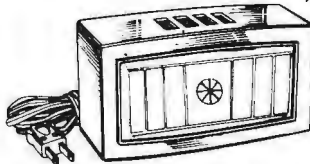
EACH

\$1

- 1.2 Volt
- Made By 3 Famous Manufacturers

SMOKE & GAS ALARM

XM-646



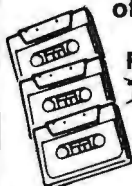
REG.
19.99

14⁹⁹

- Protects Your Family From Fire & Smoke
- Loud Horn Warning

CASSETTES

Pkg. of 3 TA-879



REG.
1.49

79¢

- 60-Minute Blank

NICKEL CADMIUM 275 BATTERY PACKS

LOW AS



- Standard Penlight Size
- Rechargeable Over & Over
- 2-"AA" Batt. Pack. 2.4 Volts BA-359..... Ea. 2.00
- 3-"AA" Batt. Pack. 3.6 Volts BA-327..... Ea. 3.00
- 4-"AA" Batt. Pack. 4.8 Volts BA-361..... Ea. 4.00

VHF-AM PORTABLE 3-CHANNEL RECEIVER

RA-422



22⁹⁹

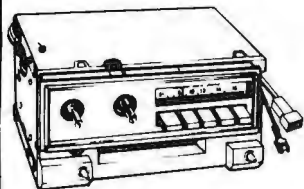
Was ~~39~~
in 677 Cat.

- Hear (HI-VHF 150-175 mHz) Police, Weather, Fire, More!
- Hurry! Quantities Limited
- Just Install Crystals Needed
- 9V Battery Included
- XM-677 Crystals Ea. 1.29

AUTO RADIO PUSHBUTTON AM

AU-580

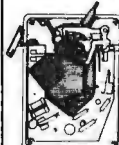
10⁹⁹



- Mounts In or Under-Dash
- Has Volume, Tone and Manual Tuning Controls
- 12 VDC Negative Ground

EXPERIMENTER'S WIDGET CAMERA SHUTTER ASSEMBLY

XM-637



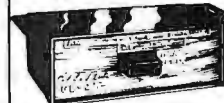
99¢

- Photo Cell, Resistors, Capacitor
- Electronic Shutter for Camera

CB MONITOR CONVERTER CHANNELS 1 THRU 23

CB-417

4⁹⁹

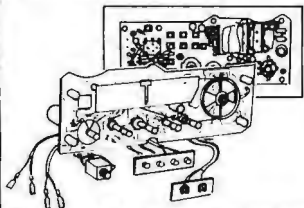


- Converts AM Auto Radio to CB Monitor
- For Traffic & Road Condition Reports

MONO FM-AM RECEIVER CHASSIS

RA-573

7⁹⁹



- Mono Phono Input
- AM-FM Antennas
- Tape Output •Head Phone Jack
- For 11-12 VDC Operation
- Stereo Version of Above RA-574..... 9.99

RESISTORS ONLY 100 PIECE ASSORTED KIT

79¢

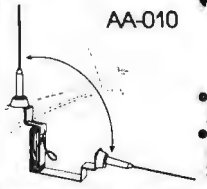
RR-077



- Less Than 1¢ Each
- 1/4-1/2, 1 Watt Resistors

DISAPPEARING "FLIP-FLOP" ANTENNA TRUNK MOUNT

AA-010



- Conceal Your Antenna
- Installs in Minutes Without Special Tools

2" PM SPEAKER

2/1.50 SS-295



- Replacement for Radios, Recorders, Etc.
- 8 to 10 Ohms Impedance

8 OHM EARPHONES



PH-405

49¢

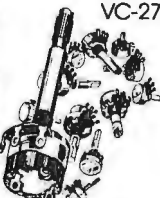
Was ~~1.49~~
in 677 Cat.

- Pkg. of 4
- Earphones Without Plugs

VOLUME CONTROLS

Pkg. of 12 ONLY

59¢



- Various Diameters & Lengths
- Some Have Switches

40 TERMINAL STRIPS

XM-501



69¢

- Ass't Lengths and Various Number of Terminal Solder Lugs

Olson® electronics
260 S. FORGE ST.
DEPT. I-5 AKRON, OHIO 44327

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

QTY	STK #	DESCRIPTION	PRICE EA	TOTAL

HARDWARE KIT 1 POUND

Reg. ~~79¢~~ EA.

HW-076

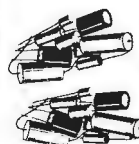


50¢

- Large Assortment of Screws, Washers, Nuts, Bolts, Etc.
- Big 5 lb. Version. Wt. 5 lbs HW-181. Reg. ~~2.49~~ 1.00

50-PC. LOW VOLTAGE CAPACITOR KIT

CD-407



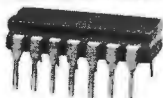
2⁵⁰

- Axial and Radial Lead Types
- Low Voltage, High Capacity Types

ANNOUNCING NEW LOW PRICES AT RADIO SHACK, THE "PARTS PLACE"

Top quality devices, fully functional, carefully inspected. Guaranteed to meet all specifications, both electrically and mechanically. All are made by well known American manufacturers, and all have to pass

manufacturer's quality control procedures. These are not rejects, not fallouts, not seconds. In fact, there are none better on the market! Count on Radio Shack for the finest quality parts.



TTL Digital ICs

First Quality Devices Made by National Semiconductor and Motorola

Type	Cat No.	Last Year	NOW ONLY
7400	276-1801	\$ 49	35¢
7402	276-1811	\$ 49	39¢
7404	276-1802	\$ 59	35¢
7406	276-1821	\$ 69	49¢
7410	276-1807	\$ 49	39¢
7413	276-1815	\$ 119	75¢
7420	276-1809	\$ 49	39¢
7427	276-1823	\$ 69	49¢
7432	276-1824	\$ 69	49¢
7441	276-1804	\$ 159	99¢
7447	276-1805	\$ 199	99¢
7448	276-1816	\$ 199	99¢
7451	276-1825	\$ 49	39¢
7473	276-1803	\$ 79	49¢
7474	276-1818	\$ 79	49¢
7475	276-1806	\$ 119	79¢
7476	276-1813	\$ 79	59¢
7485	276-1826	\$ 159	1.19
7486	276-1827	\$ 69	49¢
7490	276-1808	\$ 119	79¢
7492	276-1819	\$ 119	69¢
74123	276-1817	\$ 169	99¢
74145	276-1828	\$ 149	1.19
74150	276-1829	\$ 179	1.39
74154	276-1834	\$ 179	1.29
74192	276-1831	\$ 169	1.19
74193	276-1820	\$ 169	1.19
74194	276-1832	\$ 169	1.19
74196	276-1833	\$ 169	1.29

74C and 4000 Series CMOS ICs

74C00	276-2301	\$ 69	49¢
74C02	276-2302	\$ 69	49¢
74C04	276-2303	\$ 69	49¢
74C08	276-2305	\$ 69	49¢
74C74	276-2310	\$ 129	89¢
74C76	276-2312	\$ 159	89¢
74C90	276-2315	\$ 229	1.49
74C192	276-2321	\$ 249	1.69
74C193	276-2322	\$ 249	1.69
4001	276-2401	\$ 69	49¢
4011	276-2411	\$ 69	49¢
4013	276-2413	\$ 129	89¢
4017	276-2417	\$ 249	1.49
4020	276-2420	\$ 249	1.49
4027	276-2427	\$ 129	89¢
4049	276-2449	\$ 99	69¢
4050	276-2450	\$ 99	69¢
4511	276-2447	\$ 269	1.69
4518	276-2490	\$ 249	1.49

Linear ICs

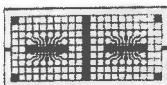
First Quality Devices by National Semiconductor and Motorola



Type	Cat No.	Last Year	NOW ONLY
301AH	276-017	\$ 69	49¢
324N	276-1711	\$ 199	1.49
359N	276-1712	\$ 199	1.49
386CN	276-1731	\$ 199	99¢
555CN	276-1723	\$ 149	79¢
556CN	276-1728	\$ 279	1.39
566CN	276-1724	\$ 299	1.69
567CN	276-1721	\$ 299	1.99
723CN	276-1740	\$ 99	69¢
741CN	276-007	\$ 69	49¢
741H	276-010	\$ 69	49¢
3900N	276-1713	\$ 139	99¢
3909N	276-1705	\$ 129	99¢
3911N	276-1706	\$ 129	99¢
4558CN	276-038	\$ 99	79¢
75491	276-1701	\$ 149	99¢
75492	276-1702	\$ 149	99¢
7805	276-1770	\$ 159	1.29
7812	276-1771	\$ 159	1.29
7815	276-1772	\$ 159	1.29

Experimenter's PC Board

Simplifies IC Projects



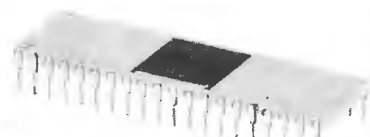
Ideal for two-circuit projects. Fire-retardant copper-clad board is only 2 1/2 x 5 x 1/16". Really simplifies integrated circuit projects by extending leads for easy soldering.

276-151 2.99

Microcomputer Chip

8080A Microprocessor. With a 16-bit address bus capable of addressing up to 65k bytes of memory and up to 256 I/O ports. "TRI-State" data bus gives it DMA and multiprocessing capability. All buses TTL compatible. Up to 244 variable length instructions, with 6 general purpose registers plus an accumulator. 40-pin DIP. 100% Prime. 276-2510 17.95

RS2102 Static RAM. 1024-word by one bit random access read/write memory. Under 750 nS access. Single +5V power supply. 276-2501 2.49 each or 8/14.95



1795

LEDs/Optoelectronics

Item	Cat No.	Reg	Now Only
A. Solar Cell	276-115		1.99
B. Silicon Solar Cell	276-128		1.59
C. Photocell	276-116		99¢
D. PPT 100	276-130	2/69¢	79¢
E. Lq Red LED	276-041	2/69¢	2/49¢
F. Lq Cir LED	276-047	2/69¢	2/49¢
G. Med Red LED	276-026	2/69¢	2/49¢
H. Med Cir LED	276-040	2/69¢	2/49¢
I. Sm Red LED	276-042	2/69¢	2/49¢

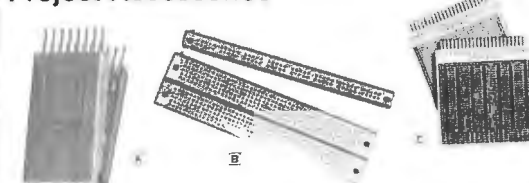
Digital Displays



Digits	Size	Drive	Cat. No.	Last Year	NOW ONLY
3	4 0.5"	Anod.	276-1201	\$9.95	6.95
4	4 0.5"	Cath.	276-1202	\$9.95	6.95

Digits	Size	Drive	Cat. No.	Last Year	NOW ONLY
1	0.6"	Anod.	276-056	\$3.99	2.99
1	0.6"	Cath.	276-066	\$3.99	2.99
1	0.3"	Anod.	276-053	\$2.99	1.99
1	0.3"	Cath.	276-062	\$2.99	1.99
1	0.3"	Anod.	276-1210	4/58.97	4/6.99
1	0.3"	Cath.	276-1211	4/58.97	4/6.99

Project Accessories



IC Troubleshooting Test Clip. Test up to 14 pins with probes or clips. Reg 4.99

276-1950 Sale 2.99

IC Troubleshooting Test Clip. Test up to 16 pins with probes or clips. Reg 4.99

276-1951 Sale 3.49

Experimenter Socket. 2x47 rows of 5 connected tie points. 276-172 9.95

Bus Strip. 2x40 connected tie points. 276-173 1.99

Standard Edge-Card Board. 22-pin 1295 mounting holes. 276-152 2.99

2-Voltage Source Edge-Card Board. 1368 mounting holes. 276-154 2.99

3-Voltage Source Edge-Card Board. 1368 mounting holes. 276-153 2.99

22-Pin Edge-Card Board Connector. 44-terminals. 276-1551 2.99

100-Pin Edge-Card Board Connector. For standard S-100 hobby computer bus. 276-1554 4.99 each or 5/19.95

DIP Header. 16-pin spacing. 276-1980 1.29

Right Angle IC Socket. Mount LED S vertically. 16-pin spacing. 276-1985 1.49

Metal Cabinet. 3 1/2 x 2 1/2 x 4". 270-251 2.59

Metal Cabinet. 4 x 2 x 6". 270-252 3.49

Metal Cabinet. 6 1/2 x 2 1/2 x 7 1/2". 270-253 4.49

Transformers

6-3 Volts 1.2 Amps. 1 1/2 x 1 1/2 x 1 1/2". 273-050 2.29
6-3 Volts, 3 Amps. 2 1/2 x 2 1/2 x 1 1/2". 273-1510 3.99
12 Volts 5 Amps. 4 1/2 x 2 1/2". Reg. 8.95. 273-1513 Sale 6.95
18 Volts (Center Terminal), 4 Amps. Ideal for 5V (using CT), or 12V solid-state regulators. 4 1/2 x 2 1/2". Reg. 8.95. 273-1514 Sale 6.95

Selected Diodes

Type	Cat. No.	Last Year	Now Only
1N4001	276-1101		2/39¢
1N4003	276-1102	2/59¢	2/49¢
1N4004	276-1103	2/69¢	2/59¢
1N4005	276-1104	2/79¢	2/69¢
1N4735	276-561		2/89¢
1N4739	276-562		2/89¢
1N4742	276-563		2/89¢
1N4744	276-564		2/89¢
Trigger Diode	276-1050	\$ 49	39¢
1N5401	276-1141		2/69¢
1N5402	276-1142	2/89¢	2/79¢
1N5403	276-1143	2/99¢	2/89¢
1N5404	276-1144	2/51 19	2/99¢
PTC205	276-1114		3/1.39¢

SCR's and Triacs

Device	Rating	Cat. No.	Last Year	Now Only
LASCR	200V, 1.6A	276-1095	\$ 1.59	99¢
SCR	200V, 6A	276-1067	\$ 1.39	89¢
SCR	400V, 6A	276-1020	\$ 1.49	99¢
Tnac	200V, 6A	276-1001	\$ 1.39	89¢
Tnac	400V, 6A	276-1000	\$ 1.49	99¢
BR	50PIV, 1.4A	276-1151		79¢
BR	100PIV, 1.4A	276-1152		99¢
BR	100V, 4A	276-1171		1.49
BR	200V, 4A	276-1172		1.69
BR	400V, 4A	276-1173		1.89
BR	50PIV, 6A	276-1180		1.99

Digital Car Clock Module



Just add switches and install! Type MA1003, with MOS/LSI clock circuit chip, green fluorescent display with four 0.3" digits. Has 2.09 MHz crystal, blinking color activity indicator. Six-pin edge-connector. For any 12VDC source. 277-1003 24.95

Low-Profile DIP Sockets

8-Pin. 276-1995. Reg. 2 for \$.69. 2/59¢
14-Pin. 276-1999. Reg. 2 for \$ 1.19. 2/89¢
16-Pin. 276-1998. Reg. 2 for \$ 1.19. 2/89¢
28-Pin. 276-1997. Reg. \$ 1.19 Each. 89¢
40-Pin. 276-1996. Reg. \$ 1.39 Each. 99¢



8-Rocker DIP Switch

Incorporates 8 on-off switches. For easy change of preset logic states. Fits any 16-DIP socket. 275-1301 1.99



WHY WAIT FOR MAIL DELIVERY?
IN STOCK NOW AT OUR STORE NEAR YOU!

Prices May Vary at Individual Stores and Dealers

Radio Shack®

A TANDY COMPANY • FORT WORTH, TEXAS 76102
OVER 6000 LOCATIONS IN NINE COUNTRIES

EDI

Dept. PEI • 4900 Elston Avenue • Chicago, Illinois 60630 • Tel. 312-283-4800



SMOKE ALARM

- U.L. Listed
- Loud Alarm Horn
- 9 Volt Battery Powered
- Built In Life Indicator

F-249 **18⁸⁸**



SCOTCH SC-90 DYNARANGE CASSETTE RECORDING TAPE

- 90 Minute
- Low Noise — High Density

CJ-22 **188** 3/5.50



40 CHANNEL CB AUTO RADIO CONVERTER

- Converts AM Car Radio To 40 Channel CB Receiver

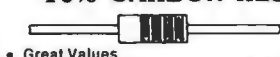
F-222 **6⁸⁸**

VENTILATION FAN — 4" BLADE

- 115V — 60 Hz
- Ideal For Cooling Electronic Equipment, Etc.
- Oilite Type Bearing For Cool Efficient Operation

N-853 **.99**

PKG/200 1/2 WATT 10% CARBON RESISTORS



- Great Values

R-70 **.66**

CHROMALOX HEAT ELEMENT

- 1500 Watt — 120V
- Size: A, 10 1/2"; B, 13-5/8"; C, 3 1/2"

N-889

.39

4/1.40

PKG/20 IN3548 DIODES

- 600 ma 500 P.V.



.49 pkg. of 20



COMPUTER GRADE CAPACITORS SPECIALS

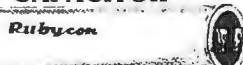
L-23	90,000 MFD	10 Volt DC	.99
L-27	100,000 MFD	15 Volt DC	1.39
L-17	4,000 MFD	25 Volt DC	1.09
L-9	5,500 MFD	25 Volt DC	.99
L-29	8,200 MFD	25 Volt DC	1.09
L-37	2,000 MFD	35 Volt DC	1.00



6KV TRIGGERING COIL

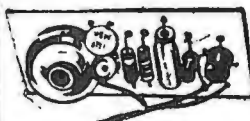
CF-46 **13⁹** 3/4.00

MINIATURE PHOTO FLASH CAPACITOR



- 600 MFD, 360 Volts • Size: 1" Dia. x 3-5/8"

L-242 **22⁹** ea. 2/4.00 10/19.00



VOICE ACTIVATED SOLID STATE SWITCH

- Locks On When Activated
- Opens When Circuit Is Momentarily Disconnected

S-45 **.88**



1 1/2-3 VOLT ADJUSTABLE DC SIGNAL HORN

- Use In Warning Devices, Alarms, Etc.

N-34 **.49** 3/1.35



FIRE/HEAT SENSOR

- Heat Sensor Closes At 135 Deg. F., Opens At 105 Deg. F.

S-2 **.49** 3/1.35

TRANSISTOR IN CIRCUIT - OUT OF CIRCUIT DYNAMIC CHECKER



- Tests Go And No Go At Currents From 5 ma To 50 ma
- Shows Current Gain, Electrical Open And Short Circuits
- Test PNP & NPN, Low, Medium and High Power Transistors.

F-144 **7⁷⁷**

12 FT. SHIELDED AUDIO CABLE



- Shielded Single Conductor
- Low Capacity Cable

H-11 **.29**



CB IN LINE POWER METER

- Monitor RF Output On 0-10 Watt Scale
- Constant In Line Monitoring

Limited Quantity

F-306 **2⁹⁹**

STROBE FLASH TUBES

For Photo-Electronic Flash Or Psychedelic Stroboscopes
Standard Tube — Similar to G.E. FT-106. Maximum Flash Voltage, 400; Minimum Starting Voltage (with 4KV Trigger) 200 Volts; Maximum Watt Sec. Input, 50; Approx. Life at Maximum Watt Sec., 8,000 Flashes; Approx. Life at 1 Watt Sec., 100,000 Flashes.

CF-43 **34⁹** 3/10.00 10/30.00

Deluxe Tube — Similar to G.E. FT-110. Maximum Flash Voltage, 500; Minimum Starting Voltage (with 4KV Trigger) 220 Volts; Maximum Watt Sec. Input, 100; Approx. Life at Maximum Input, 10,000 Flashes; Approx. Life at 1 Watt Sec., 200,000 Flashes.

CF-44 **42⁹** 3/12.00



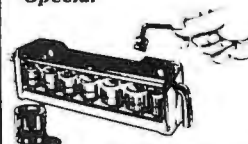
JAPANESE TRANSISTORS

Used in many Panasonic Cassette Tape Recorders, RQ209A, etc.

E-246	2SB172	AF Amp Output	.45	5/2.00
E-247	2SB172A	AF Amp Output	.45	5/2.00
E-248	2SB173	AF Amp Output	.45	5/2.00
E-249	2SB175	AF Amp Output	.45	5/2.00
E-250	2SB178	AF Amp Output	.79	3/2.00
E-251	2SB324	AF Amp Output	.79	3/2.00
E-252	2SC645A	Mix/Oscillator	.45	5/2.00

Converter RF & IF Amplifier (FM Radio) VHF Tuner, UXF OSC.

Special



SOCKET WRENCH KIT

Handy seven piece socket set with 4 1/4" handle. For all hex head screws and nuts from 1/4" thru 7/16" diameter.

N-533 **.29**

PKG/4 LED SOLID STATE LAMPS

- Low Power Consumption For IC Compatibility And Cool Operation
- 1.6 Volt/2 Volts Forward Voltage 10.0 uA Reverse Current
- Subminiature Size, Red Transparent Or Diffused (Two Models)
- Very Intense Light Source: 2.0 mcd Luminous Intensity

E-156 Pkg/4 Red Transparent
E-157 Pkg/4 Red Diffused
Your Choice **.49** pkg.

SPERRY 9-DIGIT SP-425-09 PLANA PLASMA DISPLAY



- Character Height: 0.25 Inch
- Brightness: 70 Foot Lamberts Viewing
- Distance: 15 Feet

E-208 **.66**

SIGNETICS UTILOGIC II I.C.'S



- Greater Than 1 Volt Noise Margins
 - High Capacitive Drive Capability
 - All Units Packaged With
- | | | | |
|------|---------|-------------------------|-----|
| E-69 | SP-387A | Quad 2-Input Nand Gate | .49 |
| E-70 | SP-374A | Triple 3-Input Or Gate | .39 |
| E-71 | SP-317A | Dual 4-Input Expandable | .29 |
| E-73 | SP-370A | Triple 3-Input Nor Gate | .39 |
| E-74 | SP-328A | Dual D Binary | .39 |
| E-77 | SP-380A | Quad 2-Input Nor Gate | .49 |
| E-78 | SP-334A | Dual 4-Input Expandable | .29 |



SMALL 17-KEY CALCULATOR KEYBOARD

- With On/Off Switch And K Switch
- Size: 3 1/2" H x 2 3/4" W

E-32 **.99** 3/2.75

Send for our FREE CATALOG
with Hundreds of Electronic Items
Minimum order \$3.00; allow .25 per pound shipping and .50 handling charge. Ill. residents add 5% sales tax. Prices good thru Dec. 1st, 1977 or while stocks last. Some items may be of limited quantities and subject to prior sale.

CIRCLE NO. 21 ON FREE INFORMATION CARD

EDI
Dept. PEI
4900 Elston Ave.
Chicago, IL 60630
Tel. 312-283-4800

UNIVERSAL 4K x 8 MEMORY BOARD KIT

\$69.95

32-2102-1 fully buffered, 16 address lines, on board decoding for any 4 of 64 pages, standard 4 pin buss.

EXPANDABLE F8 CPU BOARD KIT

\$99.00

featuring Fairbug PSU.1K of static ram, RS 232 interface, documentation, 64 BYTE register

4K BASIC FOR FAIRBUG F8

on paper tape \$25.00

C/MOS (DIODE CLAMPED)

74C10	-22	4012	-22	4023	-22	4042	-78
74C193	-150	4013	-40	4024	-75	4046	-2.25
4001	-22	4016	-95	4025	-40	4049	-40
4002	-22	4016	-40	4027	-40	4050	-40
4006	-120	4017	-105	4028	-88	4055	-150
4007	-22	4018	-100	4029	-110	4066	-80
4009	-42	4019	-75	4030	-22	4071	-127
4010	-42	4020	-105	4033	-150	4076	-1.05
4011	-22	4022	-95	4035	-110		

WSU-30 Hand wire wrap tool used to wrap, unwrap & strip #30 wire

\$5.30

22A. ELECTRIC CONDUCTOR	DIP SOCKETS	#30 WIRE
SPECTRA	8 PIN - 22 24 PIN - 50	WRAP WIRE
FLAT CABLE	14 PIN - 25 28 PIN - 40	SINGLE STRAND
100/5150	16 PIN - 28 40 PIN - 60	100/51.40
100/5150	18 PIN - 30	

2708 8K EPROM	\$20.95
2522 STATIC SHIFT REG	\$ 1.95
2513 CHARACTER GEN	\$ 9.95
2518 HEX 32 BIT SR	\$ 2.50
2102 1 1024 8T SR	\$.99
2107B	\$ 3.50
MK4008P	\$ 1.95
5280 4K DYNAMIC RAM	\$ 4.75
1101A-256 BIT RAM	\$.75
MM5203 UV PROM	\$ 6.95
1702A UV PROM	\$ 4.95
5204 4K PROM	\$10.95
82523	\$ 1.95
AY 51013 UART	\$ 6.95

LIGHT ACTIVATED SCR's TO 18, 200V 1A	\$ 1.10
IN 4148 (IND141)	\$1.50
MOCA-81 OPTICAL LIMIT SWITCH	\$1.90

LED READOUTS

FND 359 C.C. 4"	\$ 50	DL-704-3" C.C.	\$.95
FND 70 C.C. 4"	\$ 55	MAN-7-3" C.C.	\$.95
FND 503 C.C. 5"	\$ 85	NS 33-3 dig. array	\$.75
FND 510 C.C. 5"	\$ 85	DL 747 C.C. 6"	\$1.95

PRINTED CIRCUIT BOARD

4-1/2"x6-1/2" SINGLE SIDED EOXY BOARD 1/16" thick, unetched \$50 ea. 5/\$2.60

7 WATT LD-65 LASER DIODE IR \$8.95

2N 3820 P FET	\$.45
2N 5457 N FET	\$.45
2N2646	\$ 1.05
ER 900 TRIGGER DIODES	4 \$1.00
2N 6028 PROG. UJT	\$.65

MINIATURE MULTI-TURN TRIM POTS

100, 500, 1K, 2K, 5K, 10K, 25K, 50K, 100K, 200K, 500K 1 Meg. \$7.5 each. 3/\$2.00

CCD202-100X 100 charge coupled device image sensor

..... \$145.00

VERIPAX PC BOARD

This board is a 1/16" single sided paper epoxy board, 4 1/2"x6 1/2" DRILLED and ETCHED which will hold up to 21 single 14 pin IC's or 8, 16, or LSI DIP IC's with busses for power supply connector. \$4.00

MV 5691 YELLOW-GREEN

BIPOLAR LED \$.90

FP 100 PHOTO TRANS

..... \$.50

RED, YELLOW, GREEN or AMBER

LARGE LED's 6/\$1.00

1LS (IMCT-2)

..... \$.75

MOLEX PINS

1000/\$1.00

10 WATT ZENERS 3.9, 4.7, 5.6, 8.2, 12, 15, 18, 22, 100, 150 or 200V

ea. \$.60

1 WATT ZENERS 4.7, 5.6, 10, 12, 15, 18 or 22V

ea. \$.25

MC6860 MODEM CHIP

..... \$9.95

Silicon Power Rectifiers

PRV	1A	3A	12A	50A	125A
100	06	14	30	80	170
200	07	20	35	115	425
400	09	25	50	140	650
600	11	30	70	180	850
800	15	35	90	230	1050
1000	20	45	110	275	1250

SILICON SOLAR CELLS

2 1/4" diameter
4V at 500 ma. \$4.00

REGULATORS

309K	.....	\$ .95	340K-5, 12, 15	.....	\$ .85
723	.....	\$ .60	340T-5, 6, 8, 12	.....	\$ .60
LM 378	.....	\$ .60	320K-5 or 15V	\$1.40	15, 18 or 24V 150
320T-5, 15	.....	78 MG	.....	\$1.35	
or 24V	.....	85	79 MG	.....	\$1.35

RS232 DB 25P male

..... \$2.95

CONNECTORS DB 25S female

..... \$3.50

TRANSISTOR SPECIALS

2N3585 NPN Si TO-66	\$.95
2N3772 NPN Si TO-3	\$ 1.60
2N1546 PNP GE TO-3	\$.75
2N2068 PNP Si TO-3	\$ 1.00
2N6056 NPN Si TO-3	\$ 1.20
2N5086 PNP Si TO-92	4/\$ 1.00
2N4898 PNP TO-66	\$.60
2N404 PNP GE TO-5	5/\$ 1.00
2N3919 NPN Si TO-3 RF	\$ 1.50
MP5A 13 NPN Si TO-92	3/\$ 1.00
2N3767 NPN Si TO-66	\$.70
2N2222 NPN Si TO-18	5/\$ 1.00
2N3055 NPN Si TO-3	\$.70
2N3904 NPN Si TO-92	5/\$ 1.00
2N3906 PNP Si TO-92	5/\$ 1.00
2N5296 NPN Si TO-220	\$.50
2N6109 PNP Si TO-220	\$.55
2N638 PNP Si TO-92	\$ 1.00
2N551 7 NPN TO-92 Si	3/\$ 1.00

TTL IC SERIES

7400	-14	7445	-65	74151	-60
7401	-14	7446	-65	74153	-60
7402	-14	7447	-65	74154	-95
7403	-14	7448	-65	74155	-70
7404	-18	7450	-15	74157	-58
7405	-18	7472	-29	74161	-85
7406	-25	7473	-29	74163	-80
7407	-25	7474	-29	74164	-95
7408	-18	7475	-45	74165	-95
7409	-17	7476	-30	74173	-120
7410	-14	7480	-35	74174	-95
7411	-20	7483	-62	74175	-82
7412	-20	7485	-87	74176	-75
7413	-39	7486	-30	74177	-75
7414	-63	7489	-185	74180	-60
7415	-25	7490	-42	74181	-180
7417	-25	7491	-58	74190	-100
7420	-14	7492	-43	74191	-100
7425	-25	7493	-45	74192	-83
7426	-22	7494	-70	74193	-83
7427	-25	7495	-65	74194	-85
7430	-14	7496	-65	74195	-82
7432	-25	74107	-28	74196	-86
7437	-21	74121	-33	74257	1.25
7438	-21	74123	-65	74279	87
7440	-14	74125	-40	75324	1.75
7441	-70	74126	-40	75491	50
7442	-40	74150	-80	75492	50

M7001 ALARM CLOCK CHIP

..... \$5.75

MINIATURE DIP SWITCHES

CTS-206-4 Four SPST switches in one minidip package \$1.75

CTS-206-8 Eight SPST switches in a 16 pin dip package \$2.20

5.8V SPST miniature toggle switch, normally open, 330 Ohm coil resistance \$75, 3 \$2.00

ALCO MINIATURE TOGGLE SWITCHES

MTA 106 SPDT \$1.20

MTA 206 DPDT \$1.70

Full Wave Bridges

PRV	2A	6A	25A
100	.....	.....	1.30
200	.....	.....	2.00
400	.....	.....	3.00
600	1.20	1.75	4.00

SANKEN AUDIO POWER AMPS

Si 1010 G 10 WATTS \$ 7.95

Si 1020 G 20 WATTS \$15.95

Si 1050 G 50 WATTS \$27.95

TANTULUM CAPACITORS

22UF 35V 5 \$1.00	10UF 10V	\$.25
47UF 35V 5 \$1.00	22UF 25V	\$.40
68UF 35V 5 \$1.00	15UF 35V	3/\$1.00
1UF 35V 5 \$1.00	30UF 6V	5/\$1.00
2.2UF 20V 5 \$1.00	33UF 5V	\$.47
3.3UF 35V 4 \$1.00	47UF 20V	\$.35
4.7UF 15V 5 \$1.00	68UF 15V	\$.50
6.8UF 35V 4 \$1.00		

74LS SERIES

74LS00	-26	74LS126	65	LM 101	70
74LS02	-26	74LS132	80	LM 301/748	31
74LS03	-26	74LS136	-39	LM307	35
74LS04	-28	74LS138	-72	LM 308	95
74LS05	-28	74LS139	-72	LM 311	95
74LS08	-28	74LS151	98	LM 318	25
74LS09	-28	74LS153	93	LM 319	95
74LS10	-26	74LS155	200	LM 324	95
74LS11	-26	74LS156	95	LM 339	110
74LS12	-50	74LS157	98	LM 358	-140
74LS15	-28	74LS160	-102	LM 370	-115
74LS20	-26	74LS161	-102	LM 377	250
74LS21	-26	74LS162	102	LM 380	95
74LS22	-26	74LS163	-102	LM 381	-128
74LS26	-33	74LS168	-110	LM 382	125
74LS27	-33	74LS169	110	LM 537	750
74LS30	-26	74LS170	-172	LM 553	-250
74LS32	-33	74LS173	139	LM 555	-44
74LS37	-37	74LS174	105	LM555	-85
74LS38	-37	74LS175	122	NE540L	-275
74LS40	-27	74LS192	150	560	200
74LS42	-88	74LS191	150	565	110
74LS47	-79	74LS192	175	566	-150
74LS51	-26	74LS193	175	567	150
74LS54	-26	74LS195	-125	703	90
74LS90	-95	74LS196	-99	709	25
74LS93	-40	74LS197	99	710	35
74LS94	-40	74LS221	125	741C or V	-31
74LS96	-40	74LS257	135	747	65
74LS98	-89	74LS258	138	LM 1310	250
74LS99	-85	74LS279	75	1456	95
74LS99	-85	74LS366	66	1458	-60
74LS109	-43	74LS365	66	CA3045	75
74LS112	-43	74LS367	66	3900	49
74LS113	-43	74LS368	66	8038CC	390
74LS114	-43	74LS390	-220	UA791P5	195

TRIACS

PRV	1A	10A	25A	1.5A	6A	35A
100	40	70	130	40	50	120
200	70	110	175	60	70	160
400	110	160	260	100	120	220
600	170	230	360	150	150	300

SCR'S

PRV	1A	10A	25A	1.5A	6A	35A
100	40	70	130	40	50	120
200	70	110	175	60	70	160
400	110	160	260	100	120	220
600	170	230	360	150	150	300

Terms: FOB Cambridge, Mass. Send Check or Money Order. Include Postage. Minimum Order \$5.00. COD's \$20.00

Send 25¢ for our catalog featuring Transistors and Rectifiers 145 Hampshire St., Cambridge, Mass.

SOLID STATE SALES
P.O. BOX 74A
SOMERVILLE, MASS. 02143 TEL. (617) 547-4005

WE SHIP OVER 95% OF OUR ORDERS THE DAY WE RECEIVE THEM

MINI-KITS

FM WIRELESS MIKE KIT

FM-1 \$2.95

Transmit up to 300 ft. on any FM radio. Sensitive microphone input requires dynamic crystal or ceramic mike. Runs on 3 to 9 volts

LED BLINKY KIT

A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons or warning type panel lights.

Complete Kit, BL-1 \$2.95

SUPER-SNOOP AMPLIFIER

A super-sensitive amplifier which will pick up a pin drop 15 feet! Great for monitoring baby's room or as a general purpose test amplifier. Full 2 watts of output, runs on 5 to 12 volts. Uses any type of mike. Requires 5-45 ohm speaker

Complete Kit, BN-9 \$4.95

MUSIC LIGHTS KIT

See music come alive! 3 different lights flicker with music or voice. One light for low, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300 watts. Great for parties, band music, night clubs and more.

Complete Kit, ML-1 \$7.95

SIREN KIT

Produces loud and dramatic wail characteristic of police sirens. 200mw audio output, runs on 3-9 volts, test 5-45 ohm speaker

Complete Kit, SM-3 \$2.95

CODE OSCILLATOR KIT

Powerful audio oscillator of approx. 1 watt, good for many uses. 200mw audio output, runs on 3-9 volts, test 5-45 ohm speaker

Complete Kit, CPD-1 \$2.50

POWER SUPPLY KIT

Complete triple regulated power supply provides variable 25 volts at 200ms and 45 volts at 1 amp. 50mw load regulation, good filtering and small size. Kit test transformers. Requires 6-4V at 1 amp and 18 to 30VCT.

Complete Kit, PS-3LT \$6.95

DECADE COUNTER PARTS KIT

Includes: 7490A 32 MHz counter, 7475 latch, 7447 LED driver, LED readout, current limit resistors, hookup aids and instructions on how to build an easy low cost freq. counter.

Kit of Parts, DCU-1 \$3.50

Frequency Counter

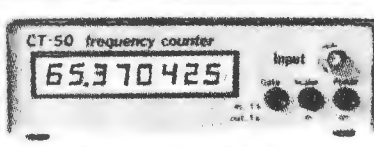
\$79.95 KIT

You've requested it, and now it's here! The CT-50 Frequency Counter Kit has more features than counters selling for twice the price. Measuring frequency is now as easy as pushing a button, the CT-50 will automatically place the decimal point in all modes, giving you quick, reliable readings. Want to use the CT-50 mobile? No problem, it runs equally as well on 12 VDC as it does on 110 VAC. Want super accuracy? The CT-50 uses the popular TV color burst freq. of 3.579545 MHz for time base. Tap off a color TV with our adapter and get ultra accuracy — .001 ppm! The CT-50 offers professional quality at the unheard of price of \$79.95. Order yours today!

CT-50, 60MHz Counter Kit \$79.95

CT-50WT, 60 MHz counter, wired and tested \$159.95

CT-600, 600 MHz prescaler option for CT-50, add.. \$29.95



UTILIZES NEW MOS-LSI CIRCUITRY

SPECIFICATIONS

Sensitivity: less than 25mV

Frequency range: 5Hz to 60MHz, typically 65MHz

Gate time: 1 second, 1/10 second, with automatic decimal point positioning on both direct and prescale

Display: 8 digit red LED 4" height

Accuracy: 10 ppm, .001 ppm with TV time base!

Input: BNC, 1 meg ohm direct, 50 ohm with prescale option

Power: 110 VAC 5 watts or 12 VDC @ 1 Amp

Size: Approx. 6" x 4" x 2", high quality aluminum case

Color burst adapter for .001 ppm accuracy available in 6 weeks. CB-1, Kit \$14.95

VIDEO TERMINAL KIT \$149.95

A compact 5 x 10-inch PC card that requires only an ASCII keyboard and a TV set to become a complete interactive terminal for connection to your microprocessor asynchronous interface. Its many features are single 5-volt supply, crystal controlled sync and baud rates (up to 9600 baud), 2 pages of 32 characters by 16 lines, read to and from memory, computer and keyboard-operated cursor and page control, parity error display and control, power-on initialization, full 64-character ASCII display, block-type see-thru cursor, keyboard/computer control backspaces, forward spaces, line feeds, rev. line feeds, home, returns cursor. Also clears page, clears to end of line, selects page 1 or 2, reads from or to memory. The card requires 5 volts at approx. 900 ma and outputs standard 75 ohm composite video.

TH3216 Kit \$149.95

TH3216, Assembled and Tested \$239.95

VD-1, Video to RF Modulator Kit \$ 6.95

SIX DIGIT 12/24 HR CLOCK KIT

Want a clock that looks good enough for your living room? Forget the competitor's kludges and try one of ours! Features: jumbo 4 1/2" digits, Polaroid lens filter, extruded aluminum case available in 5 colors, quality PC boards and super instructions. All parts are included, no extras to buy. Fully guaranteed. One to two hour assembly time. Colors: silver, gold, black, blue and bronze (specify).

Clock Kit, DC-5 \$29.95

Alarm Clock, DC-8, 12 hr. only \$24.95

DC-5 with 10 min. 10 timer \$25.95

Mobile Version, DC-7 \$25.95

Assembled and tested clocks available, add \$10.00 to kit price.

741 MINI DIP, house marked 10/\$2.00

CAR CLOCK KIT \$27.95

12/24-Hour 12-Volt AC or DC

- High Accuracy (1 minute/month)
- 6 jumbo 4 1/2" LED readouts
- Easy, no-polarity hookup
- Display blanks with ignition
- Case, mounting bracket included
- Super instructions

Complete Kit, DC-11 \$27.95

600 mHz Prescaler

Fully assembled and tested. Extend the range of your counter to 10 times higher in frequency. Works with any counter. High sensitivity input with built-in on-chip pre-amp.

PS-1B, —10 \$59.95

LINEAR REGS

555	.....	50	309K	.....	99
556	.....	75	340K-12	.....	99
566	1.49	7805	.....	99	PNP Power Tab 40W
567	1.49	7812	.....	99	PNP Power Tab 40W
324	1.49	7815	.....	99	FET MPF-102 type
1458	.....	78MG	1.50	UJT 2N2655 type	3/\$2.00
380	1.49	723	.....	49	2N3055 NPN Power

TRANSISTORS

10/\$1.00	NPN 2N3904 type
10/\$1.00	PNP 2N3906 type
3/\$1.00	PNP Power Tab 40W
3/\$1.00	

struction manual, schematic or any available information. Frank R. Crim, 1321 S.W. 95th Ave., Deerfield Beach, FL 33441.

Nekermann A Korting West German radio/stereo (NR 828/43). Service manual and/or schematic. Rex Faulkner, 2677 Estelle Ct., Smyrna, GA 30080.

National Model NC-100X receiver. Schematic or manual. Edward S. Sears, 174 Charles Dr., Valparaiso, FL 32580.

Bell Model 2425 AM/FM stereo amplifier. Service manual and/or schematic. Paul Parkhill, 1094 So. 5th Ave., Kankakee, IL 60901.

RME multi-band communications receiver. Schematic and any available information. Scott Brisse, 414 Bloom, 1st Flr., Highland Park, IL 60035.

Tech Model TO-3 oscilloscope. Information, schematic and manual. John Visser, 12627 98th Ave., Surrey, British Columbia, V3U 2K7 Canada.

National Electronics Labs Type CA-1267 voice operated

relay. Schematic and operations manual. Mike Roman, 930 State St., Grinnell, IA 50112.

UMC Model 24A-C oscilloscope. Need technical manual. Sgt. Ron Hathcock, C Co 32 Sig BN Box 107, APO 09757.

Lafayette Model KT-320 shortwave receiver. Operation manual. David B. Stancel, 99 Morris Dr., Ringgold, GA 30736.

Tektronix Model 514-D oscilloscope. Need manual. Anthony Matlosz, 419 Rahway Ave., Elizabeth, NJ 07202.

Teac Model 505-3 reel-to-reel tape recorder. Need service manual. Melvin McDaniel, 1822 N. Appleton St., Baltimore, MD 21217.

W.T. Grant Model 1004B30 9-inch TV receiver. Schematic and service information. James E. Saffin, 919 Ford Ave., Ogdensburg, NY 13669.

Midland Model MID 7040A07 cassette recorder. Need schematic. Fabian Velazquez V. Virrey de Mendoza, 937 Morelia, Michoacan, Mexico.

Lexington (Div. Concord Electronics) Model LE-1 stereo receiver. Schematic and service information. Frank, 217 Ridgedale Ave., Florham Park, NJ 07932.

Rider radio manuals Vol. I through XXIII. D.A. Swindal, 1112 San Jose Ln., Hanahan, SC 29406.

Ampex Model 008 stereo console. Need schematic. K.G. Brown, 5032 Gilbert Dr., Fort Worth, TX 76116.

Eico Model 753 transceiver. Need source of No. 751 ac power supply. R.J. Hickey, Box 673, Comer Brook, New Foundland, Canada.

Heath Model EV805A universal digital instrument. Schematics, instructions and/or manuals. J. Baker, 1718 E. Galer, Seattle, WA 98112.

Bell & Howell Model 2295 tape recorder. Need schematic. IT&T Model 6521 FX stereo combination equipment. Schematic. G.W. Farr, 85 Violet Ln., Lakeland, FL 33801.

Magnatone Model 200 hi-fi stereo vibrato. Schematic, tube

(Continued on page 118)

ACUSTIC COUPLER BY NOVATION
\$47.50

This originate only coupler was manufactured for use in T.I. 725 data terminal. It is compatible with Bell 101 and 113 data sets or the equivalent. The coupler operates asynchronously to a maximum speed of 300 baud in the full or half duplex mode. All signal output are compatible with TTL. Transmit freq. is 1270Hz. for mark and 1070Hz. for space. Receive freq. is 2225Hz. for mark and 2025Hz. for space. Unit requires ± 12 volts and +5 volts for operation. Complete with schematic and all pertinent information. fully reconditioned, calibrated and guaranteed.

RS232 TO TTL TO RS232 CONVERTER KIT
\$4.50
COMPLETE KIT WITH COMPONENTS \$6.50

P.C. BOARD MATERIAL
1/16" glass epoxy copper clad.
1 oz. 2-sided or 2 oz. 1-sided.
size 10 100
3"x6" 2.50 19.95
5"x7" 4.00 29.95
6"x6" 4.00 29.95
4"x12" 5.00 39.95
Contact ACE For Quotes On Custom Sizes.

ETCH MATERIAL
Ace makes it easy with etch powder. Etch'em to your own specifications.
EP-1.....makes.....1qt.....\$1.50
EP-2.....makes.....1gal.....\$3.50
(with instructions)

HEAT-SHRINK TUBING ASST. 25' lengths in various sizes and colors.....\$2.95

TEFLON TUBING ASST. 25' lengths in various sizes and colors.....\$1.95

1% PRECISION RESISTOR ASST. 200 FOR ONLY \$4.95 ASST. contains a balanced inventory.

ZENER DIODE IN752 5.6V 400mW.....100 FOR \$5.95 1000 FOR \$49.95

1/2 LB. MIXED ELECTRONIC HARDWARE.....\$1.00

PITTMAN 12VDC MOTOR \$1.95 EACH
The Pittman runs on as low as 2 volts, rated 12 volts 250 ma. 2.8" oz. torque at 5000RPM. 1-1/8" dia. N2" long with 0.118" shaft. New, guaranteed.....10 for \$15.00

STANDARDS KIT
An assortment of precision components for calibration of test equipment. Kit includes (10) assorted 1% capacitors, (10) assorted 0.01% resistors, and (1) temperature compensated zener reference diode. ONLY.....\$6.95

KYNAR WIRE WRAP WIRE
Solid silver plated 30 AWG. blue, red, yellow, black, green, or white.
100' spool.....\$2.50
500' spool.....\$5.95
1000' spool.....\$9.95
26AWG red or black
500' spool.....\$7.95
1000' spool.....\$12.50

BISMUTH ALLOY
Melts in boiling water. 4oz. ingot \$3.95 1lb. ingot \$9.95
FUN TO PLAY WITH!

TRIAC
G.E. SC51B 15A 200V in press fit case. Ideal for color organs.
10 for \$7.50 \$1.00 ea

HEWLETT PACKARD
7730 .3" char. RED common anode ONLY \$.75 EACH!
1N914B 100/\$4.95 1000/\$39.95

COMPUTER GRADE CAPS
32D COMPLYTIC 5900MFD-60VDC 10/\$12.50 24,000MFD-50V \$4.50 EA

INFRARED SENSOR PAIR
1 ea. Infrared LED \$1.00/set
1 ea. Infrared Detector

MINI KIT
60HZ. CRYSTAL TIME BASE MINI KIT INCLUDES MMS369 AND 3679.545MHZ. CRYSTAL WITH SCHEMATIC.....\$3.95

EAGLE - PITCHER
CF6V5 6 volt 5 A.H. spill - proof, rechargeable battery.
\$12.50 ea.
10 for \$99.95
NEW: 1 YEAR WARRANTY

10-TURN PRECISION POT
Spectrol, model 534 $\pm 5\%$ res. and $\pm .25\%$ lin. $\frac{1}{2}x$ " shaft. Available in 5K, 10K, or 50K \$2.50 ea. Any 10 for \$19.95

MOTOROLA WATT AUDIO AMP
ONLY \$4.99 EACH Same as MFC6070 in 8 pin mini dip. 10 FOR \$3.95 W/DATA

SEND FOR OUR FREE CATALOG

ACE ELECTRONIC TERMS: Include check or money order. NO C.O.D. Texas residents add 5% tax. 5400 Mitchelldale B-8 Canada and Mexico add \$2.50. Overseas Houston, Texas 77092 countries add \$5.00 for surface rates. (713) 688-8114 We pay postage up to 10 pounds.

CIRCLE NO. 2 ON FREE INFORMATION CARD

NOVEMBER 1977

NEW LSI TECHNOLOGY
FREQUENCY COUNTER

TAKE ADVANTAGE OF THIS NEW STATE-OF-THE-ART COUNTER FEATURING THE MANY BENEFITS OF CUSTOM LSI CIRCUITRY. THIS NEW TECHNOLOGY APPROACH TO INSTRUMENTATION YIELDS ENHANCED PERFORMANCE, SMALLER PHYSICAL SIZE, DRASTICALLY REDUCED POWER CONSUMPTION [PORTABLE BATTERY OPERATION IS NOW PRACTICAL], DEPENDABILITY, EASY ASSEMBLY AND REVOLUTIONARY LOWER PRICING!



FEATURES AND SPECIFICATIONS:

DISPLAY: 8 RED LED DIGITS .4" CHARACTER HEIGHT
GATE TIMES: 1 SECOND AND 1/10 SECOND
[AUTO DEC. PT. PLACEMENT]
RESOLUTION: 1 HZ AT 1 SECOND, 10 HZ AT 1/10 SECOND.
FREQUENCY RANGE: 10 HZ TO 60 MHZ. [65 MHZ TYPICAL].
SENSITIVITY: 10 MV RMS TO 50 MHZ, 20 MV RMS TO 60 MHZ TYP.
INPUT IMPEDANCE: 1 MEGOHM AND 20 PF.
[DIODE PROTECTED INPUT FOR OVER VOLTAGE PROTECTION.]
ACCURACY: ± 1 PPM [$\pm .0001\%$]; AFTER CALIBRATION TYPICAL.
STABILITY: WITHIN 1 PPM PER HOUR AFTER WARM UP [.001% XTAL]
IC PACKAGE COUNT: 8 [ALL SOCKETED]
INTERNAL POWER SUPPLY: 5.2 V DC AT 800 MA. REGULATED.
INPUT POWER REQUIRED: 8-12 VDC OR 115 VAC AT 50/60 HZ.
POWER CONSUMPTION: 4 WATTS
INPUT CONNECTOR: BNC TYPE

SIZE: 3" High
COLOR: 6" Wide
BLACK 5 1/2" Deep

ORDER BY PHONE OR MAIL
COD ORDERS WELCOME

KIT#FC-50C 60 MHZ COUNTER WITH CABINET & P.S. \$119.95

KIT#PSL-650 650 MHZ PRESCALER [NOT SHOWN] 29.95

MODEL#FC-50WT 60 MHZ COUNTER WIRED, TESTED & CAL. 165.95

MODEL#FC-50/600 WT. 600 MHZ COUNTER WIRED, TESTED & CAL. 199.95

KIT#FC-50C IS COMPLETE WITH PREDRILLED CHASSIS ALL HARDWARE AND STEP-BY-STEP INSTRUCTIONS. WIRED & TESTED UNITS ARE CALIBRATED AND GUARANTEED. PRESCALERS WILL FIT INSIDE COUNTER CABINET.

TERMS: FOR SHIPPING, HANDLING & INSURANCE
TO US & CANADA ADD 5% ALL OTHERS 10%.
FLORIDA RES. ADD 4% SALES TAX. COD CHARGE \$1.00.

master charge
BANKAMERICARD
welcome here

OPTOELECTRONICS, INC.
BOX 219 • HOLLYWOOD, FLA. 33022 • (305) 921-2056

CIRCLE NO. 41 ON FREE INFORMATION CARD

117

World's Lowest IC Prices

MEMORIES								
UNIT	DEVICE	UNIT PRICE	74165	80	741515	23	74L8757	1 50
Rams								
			74172	25	74L870	23	74L8798 <td>1 50</td>	1 50
			74174	75	74L871	23	74L8800 <td>35</td>	35
			74175	75	74L872	23	74L8861	2 75
			74177	70	74L876	23	74L8926 <td>2 75</td>	2 75
			74180	67	74L877	27	74L8930 <td>75</td>	75
			74181	1 50	74L878	23	74L8990 <td>80</td>	80
			74189	85	74L830	23	74L8993	1 65
			74192	70	74L832	33	74L8365 <td>65</td>	65
			74193	70	74L833	33	74L8365 <td>65</td>	65
			74194	85	74L837	33	74L8367 <td>65</td>	65
			74195	68	74L838	33	74L8388 <td>65</td>	65
			74198	1 25	74L840 <td>35</td> <td>74L8375<td>15</td></td>	35	74L8375 <td>15</td>	15
			8607	50	74L841 <td>65</td> <td>74L8348<td>40</td></td>	65	74L8348 <td>40</td>	40
			8310	75	74L851 <td>23</td> <td>74L8385<td>1 75</td></td>	23	74L8385 <td>1 75</td>	1 75
			9372	75	74L854 <td>23</td> <td>74L8390<td>7 25</td></td>	23	74L8390 <td>7 25</td>	7 25
CMOS								
SCOTTEY								
	1MS 2408	2 00	74S01	25	74L873	39	4802	15
	MM 1013	1 50	74S02	25	74L874	39	4801	15
	MS 2560	1 50	74S03	25	74L876	39	4806	10
	MM 0028H	2 25	74S07	40	74L878	39	4808	10
			74S28	60	74L818	39	4807	16
TTL								
	7400	12	74S85	2 00	74L824	39	4809	10
	7402	14	74S113	1 50	74L881	1 50	4811	18
	7403	17	74S138	3 00	74L886	39	4812	16
	7404	19	74S139	1 50	74S090	57	4813	20
	7406	16	74S140	5 00	74L892	57	4815	80
	7407	20	74S151	1 50	74L893	55	4816	75
	7410	17	74S152	2 50	74S095	1 50	4819	25
	7416	25	74S157	4 50	74L8117	39	4820	80
	7420	12	74S174	2 00	74L8199	39	4821	95
	7427	26	74S175	2 50	74L8112	39	4823	16
	7430	12	74S181	2 00	74L8113	39	4829	20
	7432	26	74S193	7 25	74S114	39	4827	40
	7438	12	74S271	1 50	74L8129	49	4828	60
	7441	65			74L8137	49	4830	25
	7449	60			74L8137	89	4834	95
	7450	14	74H04	20	74L8138	39	4837	60
	7451	67	74H04	20	74L8139	39	4841	75
	7473	28	74H10	20	74L8140	39	4844	70
	7474	28	74H11	20	74L8151	75	4849	35
	7475	40	74H10	20	74L8163	75	4850	35
	7480	35	74H10	20	74L8194	1 00	4856	65
	7483	68	74H11	20	74L8197	75	4868	35
	7486	28	74H27	20	74L8198	75	4873	15
	7488	40	74H24	40	74L8199	1 00	4878	16
	7489	45	74H106	50	74L8160	1 00	4881	16
	7493	44			74L8161	1 00	4816	85
	7495	49			74L8161	1 00	4828	75
LINEARS								
	74102	25	74S04	23	74L8164	1 00		
	74150	60	74L800	23	74L8170	1 00		
	74151	60	74L501	23	74L8173	1 30		
	74152	60	74L502	23	74L8174	1 00		
	74156	60	74L903	23	74L8175	1 00		
	74159	60	74L504	25	74L8181	5 00		
	74160	60	74L505	25	74L8190	1 70		
	74161	60	74L506	25	74L8191	1 70		
	74169	1 50	74L508	23	74L8197	1 50		
	74178	1 50	74L509	27	74L8193	1 50		
	74179	1 50	74L510	23	74L8194	1 25		
	74181	69	74L511	23	74L8199	1 25		
	74184	69			74L8221	1 25		
	74185	64	74L513	64	74L8251	1 50		
	74186	1 50	74L514	100	74L8253	1 50		

Schematic and owners manual. Joaquin A. Araujo, 225 La-
vaca St., San Antonio, TX 78210.

Wards Model JWR784A airline phonograph. Need tube
#35L6 GT and schematic. Van Duncan, 2338 Woodhurst
Dr., Richmond, VA 23233.

Precision Apparatus Series 10-54 tube and set tester. Op-
erating instructions, schematic and parts list. Martin A. Wein-
er, 16 Judith Ln., Monsey, N.Y. 10952.

RCA Model RBC-1/CRV-46148 receiver and Model
CRV-20130 power supply. Schematic and alignment in-
structions. Paul E. Solheim, 1115 1st Ave. N., Great Falls,
MT 59401.

Estey Electronics Orcoo concert organ. Need power trans-
former #66-0003A. Howard Watts, 3040A Whittier, St. Louis,
MO 63115.

United Scientific Labs Contact—23 CB radio. Schematic
and operation manual. Charles McKinney, 1115½ Speed-
way, Parimont, WV 26554.

Astrodata Model 6190 time code generator. Operation and
maintenance manuals. Michael Schulsinger, 1002 Wood-
lawn Ave., Springfield, OH 45504.

Hallcrafters Model RBY-1, Type CHL-46195 receiver. Need
schematic, service information and operation manual.
George A. Mikulka, 42 Roseleah Dr., Waterford, CT 06385.

Truetone Model DC-4850 auto radio. Schematic and parts
list. **Sylvania Model 4315M** hi-fi record player. Need model
number and manual for record changer used with player.
Charles D. Prater, Edna, KY 41419.

Solar Model CE capacitor checker. Need manual and sche-
matic. Maurice Trego, 1612 E. 31st Court, Des Moines, IA
50317.

Zenith Model E1345 black and white television and G. E.
Trimline 500 stereo. Need schematics. Michael Persic,
18021 Karen Dr., Encino, CA 91316.

Tektronix Model 585A oscilloscope and I.T.&T Model
1735D oscilloscope. Schematics and manuals. A.F. Carlson,
University of Miami, Chemistry Dept., Box 249148, Coral Ga-
bles, FL 33124.

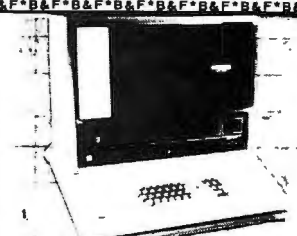
For
faster
service

USE
ZIP
CODE

on
all
mail

KEY-TO-MAGNETIC TAPE RECORDER

Singer/Portec 4301-7 & 4311-7 systems
with display station, keyboard, 7 track
magnetic data recorder, controller, etc.
Units are used, and were in good run-
ning order when removed from service.
Sold "AS IS", tapes not included, ship-
ped via truck, freight collect — customer
pays all shipping. Manuals available
separately. Sh. Wt. 200 Lbs.
Md. 4301-7 \$218.88
Complete Manual . . . \$28.50
Md. 4311-7 (includes remote data com-
munication channel) \$248.88
Complete Manual . . . \$28.50



OTHER SINGER SYSTEMS . . . includ-
ing Md. 52 Line Printer, Work Station,
Employee Entrance Station, etc. . . are
available from B&F. Send for catalog.



SPEAKER SYSTEMS KIT

Fantastic air-suspension enclosures, de-
signed for direct dispersion of high fre-
quency tones and wide dispersion of the
bass tones. Size: 17 x 10½ x 9½". Sold
with two 8" woofers; two 4" dome
tweeters; two crossover networks; grill
cloth and instructions . . . all the parts
you need to build a pair of quality air-
suspension systems! New, all U.S. made.
Sh. Wt. 35 Lbs. 7ZU70242. \$49.50/set
CABINETS ONLY
Cabinets described above, less other
components, sold in pairs. Wt. 25 Lbs.
\$25.00/pair \$80.00/4 pairs

TV HOCKEY/ SOCCER GAME

4 games in 1, Joystick controls, LED
scoring, Novice/Expert. Features hockey
mode in which player retains & shoots
puck while stick-handling up & down ice.
2-dimensional play. 115VAC. Wt. 5 Lbs
7HU70284. \$22.50 ea. \$100.00 for 5

LASER DIODES! 6 to 9.5 W

Emit coherent infra-red, with data
& PE's Sept article on laser diodes.
Wt. 4 oz. 6M160464. \$6.88 ea.

LOGIC Power Supply KIT: 5V, 1A

5 volts, 1 amp, regulated. No case, all
other parts supplied. Sh. Wt. 3 Lbs.
7C70267. \$6.00 ea. \$15.00 for 3

Phone Orders Welcome! Charge It, with
BAC, MC or AE credit cards. No COD's.
POSTAGE: Please add postage

TV-COMPUTER INTERFACE KIT

Only \$7.88 each!

Converts any standard TV into a com-
puter monitor. Self-contained RF oscil-
lator & modulator allows easy interface
of any video output device to a standard
TV set. Kit consists of parts of a video
game, includes power supply & data.
Sh. Wt. 5 Lbs. 7ZU70213. Qty. Ltd.
\$7.88 each . . . or . . . \$48.00 for 7

B&F ENTERPRISES

Dept. "P"
119 FOSTER ST.
PEABODY, MA. 01960
(617) 531-5774

DX LISTENING

(Continued from page 93)

Holness, Fri. 1130, Sat. 0330. A Jolly
Good Show, Wed. 0030, Thu. 2030. Sa-
rah Ward, Fri. 2115, Sun. 0630.

R. Australia takes requests on Count-
down, Mon-Fri at 0900-1100, an hour
not intended for North America, but
when it can be heard if you're up; try
5995 kHz.

R. Budapest once had 0300 broad-
casts on Sunday set aside for music re-
quests, and may still have.

R. Moscow does the same Wed.
2315, Thu. 0115, 0315, 0445, 0645.

RCI accepts requests for Canadian
music for Saturday broadcasts.

R. Nederland is adding a special edi-
tion of His and Hers for North America
on Wednesday.

Folk Music. Most stations include
some of their ethnic music throughout
their transmissions. **Switzerland** is in-
stantly recognizable because of this.
BBC World Service is more methodical,
with various 15-minute series at chang-
ing times. **Radio Finland** promises Fin-
nish music of all kinds on Voices of Fin-
land, the last Tuesday of each month.

VOA has two especially good pro-
grams of music not of the US, but from

the target area—Music Time in Africa,
Sun. 1635, 1935; and in the Spanish
service, Triunfos Musicales Latinoame-
ricanos, Sun, 0035.

Week in Review. Many stations take
this approach, realizing that many listen-
ers join them on weekends who can't lis-
ten every day.

AFTS Washington carries several
weekly reviews from the domestic com-
mercial networks. You may well never
have heard them on your local affiliate,
because they are unsponsorable. World
of Religion (CBS), is on Sat. 0235, 0835,
1435, 2035. Voices in the Headlines
(ABC), with dramatic music, is reminis-
cent of movie newsreels, Sun. 1635,
2235, Mon. 0435, 1035, 1635. Washing-
ton Week (CBS), Sun. 0005, 0605,
1205, 1805. The World This Week
(CBS), Mon. 0305 and 1116. This Week
at the UN (Mutual), Sun. 0315, 0915,
1515, 2115. All these appear an hour
earlier by GMT during daylight time. And
about half the times are usually, but not
always, pre-empted for sports coverage!

CBC Northern Service Sunday Morn-
ing, "a week in the life of the world," re-
ally in depth, but entertaining,
1400-1700 (summer 1300-1600).

SBC Saturdays, 2 or 3 minutes of a

show called The Week in Switzerland.

VOA This Week, Sat. 1310, 1710,
2110, Sun. 0110.

UN Radio 15-minute English UN news
summaries weekly on Sat., but five days
a week while the General Assembly is in
session, 0230, 0545, 0845.

IBA, Israel This Week, on Sat.

Finland Review of the Week, on Sat.

BBC World Service can afford to spe-
cialize: About Britain, Sat. 0145, 0515,
1015; Europa, Sat. 1115, Sun. 0215,
2115; This Week and Africa, Sat. 0335,
0515, 1500; From the Weeklies, Fri.
2315, Sat. 0715.

R. Japan Weekly News Review, Sun.
0905, 1605, 2005, 2205; Mon. 0005 in
the general services; Sun. 2355, Mon.
0140 in regional services.

R. Australia The Week in Business,
Sat. 0210, 0810, 1410.

R. Cairo This Week in History, Sun.
2255.

Belgium The Week That Was, Sat.
0015.

Austria The Week in Austria, Sat.
0130, 0330, 0430.

Radio RSA History in the Making, last
item on Friday broadcasts.

FEBC, Manila Weekly News Review,
Sun. 0930, 1330, 1545 (not for North
America).

ABOUT YOUR SUBSCRIPTION

Your subscription to POPULAR ELECTRONICS is maintained on one of the world's most modern, efficient computer systems, and if you're like 99% of our subscribers, you'll never have any reason to complain about your subscription service.

We have found that when complaints do arise, the majority of them occur because people have written their names or addresses differently at different times. For example, if your subscription were listed under "William Jones, Cedar Lane, Middletown, Arizona," and you were to renew it as "Bill Jones, Cedar Lane, Middletown, Arizona," our computer would think that two separate subscriptions were involved, and it would start sending you two copies of POPULAR ELECTRONICS each month. Other examples of combinations of names that would confuse the computer would include: John Henry Smith and Henry Smith; and Mrs. Joseph Jones and Mary Jones. Minor differences in addresses can also lead to difficulties. For example, to the computer, 100 Second St. is not the same as 100 2nd St.

So, please, when you write us about your subscription, be sure to enclose the mailing label from the cover of the magazine—or else copy your name and address exactly as they appear on the mailing label. This will greatly reduce any chance of error, and we will be able to service your request much more quickly.

P.O. Box 4430C Santa Clara, CA 95054
(408) 988-1640

Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

740000	17	74LS00	30	LM377	4.50	740011	22	74C14	2.10
740001	17	74LS01	35	LM379	9.00	740012	22	74C20	2.10
740002	17	74LS02	47	LM380	1.00	740013	22	74C28	2.10
740003	18	74LS03	51	LM381	1.00	740014	22	74C44	2.95
740004	18	74LS04	51	LM382	1.00	740015	22	74C47	2.95
740005	23	74LS05	51	LM383	1.00	740016	22	74C47	2.95
740006	23	74LS06	51	LM384	1.00	740017	22	74C47	2.95
740007	23	74LS07	51	LM385	1.00	740018	22	74C47	2.95
740008	23	74LS08	51	LM386	1.00	740019	22	74C47	2.95
740009	23	74LS09	51	LM387	1.00	740020	22	74C47	2.95
740010	23	74LS10	51	LM388	1.00	740021	22	74C47	2.95
740011	23	74LS11	51	LM389	1.00	740022	22	74C47	2.95
740012	23	74LS12	51	LM390	1.00	740023	22	74C47	2.95
740013	23	74LS13	51	LM391	1.00	740024	22	74C47	2.95
740014	23	74LS14	51	LM392	1.00	740025	22	74C47	2.95
740015	23	74LS15	51	LM393	1.00	740026	22	74C47	2.95
740016	23	74LS16	51	LM394	1.00	740027	22	74C47	2.95
740017	23	74LS17	51	LM395	1.00	740028	22	74C47	2.95
740018	23	74LS18	51	LM396	1.00	740029	22	74C47	2.95
740019	23	74LS19	51	LM397	1.00	740030	22	74C47	2.95
740020	23	74LS20	51	LM398	1.00	740031	22	74C47	2.95
740021	23	74LS21	51	LM399	1.00	740032	22	74C47	2.95
740022	23	74LS22	51	LM400	1.00	740033	22	74C47	2.95
740023	23	74LS23	51	LM401	1.00	740034	22	74C47	2.95
740024	23	74LS24	51	LM402	1.00	740035	22	74C47	2.95
740025	23	74LS25	51	LM403	1.00	740036	22	74C47	2.95
740026	23	74LS26	51	LM404	1.00	740037	22	74C47	2.95
740027	23	74LS27	51	LM405	1.00	740038	22	74C47	2.95
740028	23	74LS28	51	LM406	1.00	740039	22	74C47	2.95
740029	23	74LS29	51	LM407	1.00	740040	22	74C47	2.95
740030	23	74LS30	51	LM408	1.00	740041	22	74C47	2.95
740031	23	74LS31	51	LM409	1.00	740042	22	74C47	2.95
740032	23	74LS32	51	LM410	1.00	740043	22	74C47	2.95
740033	23	74LS33	51	LM411	1.00	740044	22	74C47	2.95
740034	23	74LS34	51	LM412	1.00	740045	22	74C47	2.95
740035	23	74LS35	51	LM413	1.00	740046	22	74C47	2.95
740036	23	74LS36	51	LM414	1.00	740047	22	74C47	2.95
740037	23	74LS37	51	LM415	1.00	740048	22	74C47	2.95
740038	23	74LS38	51	LM416	1.00	740049	22	74C47	2.95
740039	23	74LS39	51	LM417	1.00	740050	22	74C47	2.95
740040	23	74LS40	51	LM418	1.00	740051	22	74C47	2.95
740041	23	74LS41	51	LM419	1.00	740052	22	74C47	2.95
740042	23	74LS42	51	LM420	1.00	740053	22	74C47	2.95
740043	23	74LS43	51	LM421	1.00	740054	22	74C47	2.95
740044	23	74LS44	51	LM422	1.00	740055	22	74C47	2.95
740045	23	74LS45	51	LM423	1.00	740056	22	74C47	2.95
740046	23	74LS46	51	LM424	1.00	740057	22	74C47	2.95
740047	23	74LS47	51	LM425	1.00	740058	22	74C47	2.95
740048	23	74LS48	51	LM426	1.00	740059	22	74C47	2.95
740049	23	74LS49	51	LM427	1.00	740060	22	74C47	2.95
740050	23	74LS50	51	LM428	1.00	740061	22	74C47	2.95
740051	23	74LS51	51	LM429	1.00	740062	22	74C47	2.95
740052	23	74LS52	51	LM430	1.00	740063	22	74C47	2.95
740053	23	74LS53	51	LM431	1.00	740064	22	74C47	2.95
740054	23	74LS54	51	LM432	1.00	740065	22	74C47	2.95
740055	23	74LS55	51	LM433	1.00	740066	22	74C47	2.95
740056	23	74LS56	51	LM434	1.00	740067	22	74C47	2.95
740057	23	74LS57	51	LM435	1.00	740068	22	74C47	2.95
740058	23	74LS58	51	LM436	1.00	740069	22	74C47	2.95
740059	23	74LS59	51	LM437	1.00	740070	22	74C47	2.95
740060	23	74LS60	51	LM438	1.00	740071	22	74C47	2.95
740061	23	74LS61	51	LM439	1.00	740072	22	74C47	2.95
740062	23	74LS62	51	LM440	1.00	740073	22	74C47	2.95
740063	23	74LS63	51	LM441	1.00	740074	22	74C47	2.95
740064	23	74LS64	51	LM442	1.00	740075	22	74C47	2.95
740065	23	74LS65	51	LM443	1.00	740076	22	74C47	2.95
740066	23	74LS66	51	LM444	1.00	740077	22	74C47	2.95
740067	23	74LS67	51	LM445	1.00	740078	22	74C47	2.95
740068	23	74LS68	51	LM446	1.00	740079	22	74C47	2.95
740069	23	74LS69	51	LM447	1.00	740080	22	74C47	2.95
740070	23	74LS70	51	LM448	1.00	740081	22	74C47	2.95
740071	23	74LS71	51	LM449	1.00	740082	22	74C47	2.95
740072	23	74LS72	51	LM450	1.00	740083	22	74C47	2.95
740073	23	74LS73	51	LM451	1.00	740084	22	74C47	2.95
740074	23	74LS74	51	LM452	1.00	740085	22	74C47	2.95
740075	23	74LS75	51	LM453	1.00	740086	22	74C47	2.95
740076	23	74LS76	51	LM454	1.00	740087	22	74C47	2.95
740077	23	74LS77	51	LM455	1.00	740088	22	74C47	2.95
740078	23	74LS78	51	LM456	1.00	740089	22	74C47	2.95
740079	23	74LS79	51	LM457	1.00	740090	22	74C47	2.95
740080	23	74LS80	51	LM458	1.00	740091	22	74C47	2.95
740081	23	74LS81	51	LM459	1.00	740092	22	74C47	2.95
740082	23	74LS82	51	LM460	1.00	740093	22	74C47	2.95
740083	23	74LS83	51	LM461	1.00	740094	22	74C47	2.95
740084	23	74LS84	51	LM462	1.00	740095	22	74C47	2.95
740085	23	74LS85	51	LM463	1.00	740096	22	74C47	2.95
740086	23	74LS86	51	LM464	1.00	740097	22	74C47	2.95
740087	23	74LS87	51	LM465	1.00	740098	22	74C47	2.95
740088	23	74LS88	51	LM466	1.00	740099	22	74C47	2.95
740089	23	74LS89	51	LM467	1.00	740100	22	74C47	2.95
740090	23	74LS90	51	LM468	1.00	740101	22	74C47	2.95
740091	23	74LS91	51	LM469	1.00	740102	22	74C47	2.95
740092	23	74LS92	51	LM470	1.00	740103	22	74C47	2.95
740093	23	74LS93	51	LM471	1.00	740104	22	74C47	2.95
740094	23	74LS94	51	LM472	1.00	740105	22	74C47	2.95
740095	23	74LS95	51	LM473	1.00	740106	22	74C47	2.95
740096	23	74LS96	51	LM474	1.00	740107	22	74C47	2.95
740097	23	74LS97	51	LM475	1.00	740108	22	74C47	2.95
740098	23	74LS98	51	LM476	1.00	740109	22	74C47	2.95
740099	23	74LS99	51	LM477	1.00	740110	22	74C47	2.95
740100	23	74LS100	51	LM478	1.00	740111	22	74C47	2.95

ELECTRONICS			
pe 03 1000 per type .012		SPECIAL PRODUCTS	
pe 05 3000 pure cash .012		MC9595 Stopwatch timer	9.90
pe 015 5 per type 6.75		PC board, Mon. Pkg/bottom	5.00
pe 08		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95
pe 10		Controler, HD015-5	8.95

Electronics Classified

REGULAR CLASSIFIED: COMMERCIAL RATE: For firms or individuals offering commercial products or services, \$2.25 per word. Minimum order \$33.75. **EXPAND-AD CLASSIFIED RATE:** \$3.35 per word. Minimum order \$50.25. Frequency discount: 5% for 6 months; 10% for 12 months paid in advance. **READER RATE:** For individuals with a personal item to buy or sell, \$1.35 per word. No minimum! **DISPLAY CLASSIFIED:** 1" by 1 column (2-1/4" wide), \$260.00. 2" by 1 column, \$520.00. 3" by 1 column, \$780.00. Advertiser to supply film positives. For frequency rates, please inquire.

GENERAL INFORMATION: Payment must accompany copy except when ads are placed by accredited advertising agencies. First word in all ads set in caps. All copy subject to publisher's approval. All advertisers using Post Office Boxes in their addresses **MUST** supply publisher with permanent address and telephone number before ad can be run. Advertisements will not be published which advertise or promote the use of devices for the surreptitious interception of communications. Ads are not acknowledged. They will appear in first issue to go to press after closing date. Closing Date: 1st of the 2nd month preceding cover date (for example, March issue closes January 1st. Send order and remittance to **POPULAR ELECTRONICS**, One Park Avenue, New York, New York 10016. Attention: Hal Cymes.

FOR SALE

FREE! Bargain Catalog—I.C.'s, LED's, readouts, fiber optics, calculators parts & kits, semiconductors, parts. Poly Paks, Box 942PE, Lynnfield, Mass. 01940.

GOVERNMENT and industrial surplus receivers, transmitters, snooperscopes, electronic parts, Picture Catalog 25 cents. Meshna, Nahant, Mass. 01908.

LOWEST Prices Electronic Parts. Confidential Catalog Free. KNAPP, 3174 8th Ave. S.W., Largo, Fla. 33540.

ELECTRONIC PARTS, semiconductors, kits. FREE FLYER. Large catalog \$1.00 deposit. BIGELOW ELECTRONICS, Bluffton, Ohio 45817.

RADIO—T.V. Tubes—36 cents each. Send for free catalog. Cornell, 4213 University, San Diego, Calif. 92105.

AMATEUR SCIENTISTS, Electronics Experimenters, Science Fair Students... Construction plans—Complete, including drawings, schematics, parts list with prices and sources... Robot Man — Psychedelic shows — Lasers — Emotion/Lie Detector — Touch Tone Dial — Quadraphonic Adapter — Transistorized Ignition — Burglar Alarm — Sound Meter... over 60 items. Send 50 cents coin (no stamps) for complete catalog. Technical Writers Group, Box 5994, University Station, Raleigh, N.C. 27607.

METERS—Surplus, new, used, panel or portable. Send for list. Hanchett, Box 5577, Riverside, CA 92507.

MECHANICAL, ELECTRONIC devices catalog 10 cents. Greatest Values — Lowest Prices. Fertik's, 5249 "D", Philadelphia, Pa. 19120.

SOUND SYNTHESIZER KITS—Surf \$12.95, Wind \$12.95, Wind Chimes \$17.95, Electronic Songbird \$6.95, Musical Accessories, many more. Catalog free. PAIA Electronics, Box J14359, Oklahoma City, OK 73114.

BUGGED??? New locator finds them fast. Write, Clifton, 11500-L N.W. 7th Avenue, Miami, Florida 33168.

YOU WILL SAVE BIG MONEY! Surplus, Clearouts, Bankruptcy, Inventory, Deals. Catalog \$1 (redeemable). ET-COA Electronics, Box 741, Montreal, H3C 2V2. U.S. Inquiries.

HEAR POLICE / FIRE Dispatchers! Catalog shows exclusive directories of "confidential" channels, scanners. Send postage stamp. Communications, Box 56-PE, Com-mack, N.Y. 11725.

UNSCRAMBLERS: Fits any scanner or monitor, easily adjusts to all scrambled frequencies. Only 4" square \$29.95, fully guaranteed. Dealer inquiries welcomed. PDQ Electronics, Box 841, North Little Rock, Arkansas 72115.

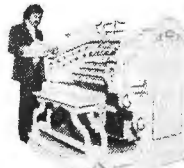
RECONDITIONED Test Equipment. \$0.50 for catalog. Walter's Test Equipment, 2697 Nickel, San Pablo, CA 94806.

POLICE/Fire scanners, large stock scanner crystals, antennas. Also CBs. Harvey Park Radio, Box 19224, Denver, CO 80219.

TELETYPE EQUIPMENT for sale for beginners and experienced computer enthusiast. Teletype machines, parts, supplies. Catalogue \$1.00 to: ATLANTIC SALES, 3730 Nautilus Ave., Brooklyn, NY 11224. Tel: (212) 372-0349.

WHOLESALE C.B., Scanners, Antennas, Catalog 25 cents. Crystals: Special cut, \$4.95, Monitor \$3.95. Send make, model, frequency. G. Enterprises, Box 461P, Clearfield, UT 84015.

BUILD AND SAVE. TELEPHONES, TELEVISION, DETECTIVE, BROADCAST Electronics. We sell construction plans with an Engineering Service. Speakerphones, Answering Machines, Carphones, Phonevans, Dialers, Color TV Converters, VTR, Games, \$25 TV Camera, Electron Microscope, Special Effects Generator, Time Base Corrector, Chroma Key. Engineering Courses in Telephone, Integrated Circuits, Detective Electronics. PLUS MUCH MORE. NEW Super Hobby Catalog PLUS year's subscription to Electronic News Letter, \$1.00. Don Britton Enterprises, 6200 Wilshire Blvd., Los Angeles, Calif. 90048.



YES, YOU CAN BUILD AN ELECTRONIC ORGAN

That has a PIPE ORGAN SOUND

With DEVTRONIX easy to build assemblies.

Own the ultimate in organ design & sound at 1/3 the cost of commercial organs.

BROCHURE AND DEMO RECORD \$1.00



ORGANS, INC.

Dept. C
5872 Amapola Dr.
San Jose, CA 95129

NAME BRAND Digital/Analog Test Equipment. Discount prices. Free catalog. Salen Electronics, Box 82, Skokie, Illinois 60076.

SURPLUS COMPONENTS, Communication and test equipment. Illustrated catalog 25 cents. E. French, P.O. Box 249, Aurora, Illinois 60505.

CB RADIOS, monitors, crystals, CD ignitions. Southland, Box 3591-B, Baytown, Texas 77520.

TELEPHONES UNLIMITED, Equipment, Supplies, All types, Regular, Keyed, Modular. Catalog 50 cents. Box 1147E, San Diego, California 92112.

POWERFUL, ADJUSTABLE, REGULATED, THREE OUTPUT POWER SUPPLY and 900 easily removable parts in complete CARTRIVISION television recorder electronic assembly with documentation. Perfect for MICRO-PROCESSOR, IC, transistor, television, CB radio applications. \$24.95 total. Free brochure. BankAmericard, Master Charge, MADISON ELECTRONICS, INCORPORATED, 369, D55, Madison, Alabama 35758. SATISFACTION GUARANTEED.

CARBON FILM RESISTORS 1/4W, 1/2W - 1.7 cents each. FREE sample / specifications. Other components. COMPONENTS CENTER, Box 134P, New York, N.Y. 10038.

PROFESSIONAL UNSCRAMBLERS — several models that fit any scanner. Free information. Capri Electronics, 8753T Windom, St. Louis, MO 63114.

UNSCRAMBLE CODED MESSAGES from Police, Fire and Medical Channels. Same day service. Satisfaction guaranteed. Don Nobles Electronics, Inc., Rt. 7, Box 265B, Hot Springs, Arkansas 71901. (501) 623-6027.

ANYTHING ELECTRONIC — we've got it. Catalog \$1.00. Razoo, Box 1224, Cupertino, Calif.

BUILD YOUR OWN SPEAKERS AND SAVE UP TO 50%

Send for our free, fact-packed 44-page catalog manual and learn how to assemble your own multi-element stereo speakers from scratch or from kits. Our catalog includes chapters on design, construction, x-overs, enclosures, midranges, woofers, tweeters and horns. Write us today!

SPEAKERLAB

Dept. PE-A, 5500 35th N.E.
Seattle, Washington 98105



USED TEST EQUIPMENT — Tektronix, HP, GR. Write: PTI, Box 8699, White Bear Lake, MN 55110. Phone: (612) 429-2975.

WEATHER MAP RECORDERS: Copy Satellite Photographs, National-Local Weather Maps. Learn How! \$1.00. Atlantic Sales, 3730 Nautilus Ave., Brooklyn, N.Y. 11224. Tel: (212) 372-0349.

AUDIO EXPERIMENTERS, Serious Music Synthesizer Stuff: literature, kits, components, circuits and more. Send SASE for FREE INFO. CFR Associates, POB F, Newton, NH 03858.

UNSCRAMBLER SUPER SALE: Our famous Code-Breaker works with all scanners and tunes all scramble frequencies only \$29.95. COD's (501) 273-5340. Mail orders to: KRYSTAL KITS, BOX 445, BENTONVILLE, AR 72712.

SEEKING ORIGINAL JAPANESE TRANSISTORS FOR CB REPAIR? Request complete list. Compare 1 to 9 prices. 2SC710, 59 cents; 2SC517, \$3.95; 2SC799, \$3.60; 2SC1306, \$4.40; 2SC1678, \$2.25; TA7205P, \$3.90; BA521, \$3.70. BA511, \$3.40. Fuji-Svea Enterprises, Dept. P, Box 40325, Cincinnati, OH 45240.

FREE CATALOG. Solar Cells, Nicads, Kits, Calculators, Digital Watch Modules, Ultrasonics, Strobes, LEDs, Transistors, IC's, Unique Components. Chaney's, Box 27038, Denver, Colorado 80227.

MICROCOMPUTER SYSTEMS. Troubleshooting Techniques-Digital Gate Decode Chart, both \$5.00. Micro Info Assoc., Box 849, Castroville, Calif. 95012. Calif. residents add 6% tax.

QUALITY KITS, Test Equipment, Tools, Books, IC's, Components, Hobbyist Services, Newsletter, over 7000 schematics and plans. \$1 (refundable), brings big value packed catalog. Bargains! Tek-Devices, Box 19154A, Honolulu, HI 96817.

ANYONE CAN SOLDER WITH — KESTER SOLDER

DO-IT-YOURSELFERS!

Let Kester solder aid you in your home repairs or hobbies. A radio, TV, model train, jewelry, plumbing, etc. Save money — repair it yourself. Send self-addressed stamped envelope to Kester for a FREE Copy of "Soldering Simplified".

KESTER SOLDER / 4201 Wrightwood Ave.
Chicago, Ill. 60639

ELECTRONIC WIRELESS REMOTE CONTROL — operates any household appliance from 100 feet. Inexpensive. Send for free brochure. KINCAID ELECTRONICS, 1619 King Street, Alexandria, VA 22314.

DIGITAL IC's, TTL, CMOS, plans, kits and parts. Free bargain flyer. T. Wong, 103 E. B'way, Dept. 4A, New York, N.Y. 10002.

UNBELIEVABLE Goldmine of Electronic Schematics. 201 Dynamite Projects. \$9.99. Send for free project list. Special Telephone Accessory Schematics, \$5.99. Spacetech, Box 182, Gillette, N.J. 07933.

SPEAKERS — Save 60%. Factory assembled or kits. Free catalog. Quality Acoustics, 15428 Center, Harvey, Illinois 60426.

100 RESISTORS \$1.50 postpaid. SASE catalog. OK Electronics, Box 291, Dept. PE-1, Onalaska, WI 54650.

DATAPOINT PROFESSIONAL ASCII serial video terminals RS-232-B excellent, guaranteed 90 days: No. 3000, \$695; No. 3360 buffered version, \$825; No. 2200 CPU, \$2,195 F.O.B. T-C-V, Box 3067, Alexandria, Virginia 22302.

VIDEO TAPE RECORDERS: Norelco LDL 1000/52 Records and Plays on 1/2 inch tape. Guaranteed Excellent: \$260.00, UPS Postage Paid. Gordon K. Kapes, 1127 Ridgewood Drive, Highland Park, Illinois 60035.

NEW ELECTRONIC PARTS. Stamp brings free catalog. Nudata Electronics, 104 N. Emerson Street, Mt. Prospect, IL 60056.

B&K TEST EQUIPMENT. Dinosaur discounts. Free shipping. Free catalog. Spacetron, 948 Prospect, Elmhurst, IL 60126.

FREE TELEPHONE Supply catalog. Most standard style telephones, long cords, plugs, and jacks including new modular parts. Flemco, 20272 37th Ave., N.E., Seattle, Wash. 98155.

PC BOARDS FROM YOUR ARTWORK

Our standard board is blue epoxy (epoxy composite laminate) and is as good as G-10 glass epoxy in most applications. • FAST service. All boards tinned for solderability and corrosion resistance. The following prices are postpaid and for boards up to 12" x 12". BASIC PRICE: .11 /sq. in. For 2 sided board add .05 /sq. in. For G-10 glass epoxy add .01 /sq. in. For 2oz copper add .015 /sq. in. Negative transparency (if not supplied actual size) .06 /sq. in. Holes drilled (1/8" .031 unless otherwise specified) .007 per hole. Cash with order (Check or money order, do not send currency.) VISA (BankAmericard) & MASTER CARD orders welcome. Ohio residents add sales tax. Prices subject to change without notice.

17—DIGIT Electronic Timepiece — Pink Noise Generator Kit — Free details. West Side Electronics, Box 636-P, Chatsworth, California 91311.

STOP WATCH, programmable from pocket calculator. Complete plans \$2. Carl Keene, 19022 Stingray Lane, Huntington Beach, CA 92646.

MAKE YOUR PLANS COME TRUE by using electronic kit of Touch Switch, Patrol Car Siren, Sound Switch, Singing Bird. Each Kit \$5.00 p.p.d. QMC, P.O. Box 4816, Irvine, California 92716.

WIRE AND CABLE. New expanded list — free. Ram Electronics, Box 336-P, Brookhaven, N.Y. 11719.

VERSATILE TESTER TESTOFON



For all electric & electronic tasks, indicates results by audible signal, ensures safe testing on dead & live circuits up to 600V. Tests transistors, diodes, ICs, MOS, capacitors, coils, transformers, motors, etc., off mains. Assembled TESTOFON costs \$24.95 each. Complete kit costs only \$12.45, incl. 24-pg. instruction booklet. Send check or money order to:

TACOTEST, INC., 913 Hannah, Troy, MI 48098

1930-1950 RADIO PROGRAMS. Cassette and Reel Catalogue \$1.00. Remember Radio, Dept. PE08, 951 West Pipeline, Hurst, Texas 76053.

8223 PROM programmer kit, simplify logic design by burning your truth table quickly, verify mode tests preprogrammed chips, includes 5V regulator on PCB, user supplies 12 VDC, 300 ma, send \$17.50. James Upchurch, Box 1102, Sebring, Fla. 33870.

WHY WORRY about leaving car lights on? ALARM ALERTS, with pulsing tone. VALUABLE GIFT. \$11.75. CRL Enterprises, P.O. Box 415, Export, PA 15632.

CRYSTAL CONTROLLED DIGITAL CROSSHATCH/DOT GENERATOR. Kit \$31.95, built \$41.95. Free Catalog. PHOTOLITE CORP., 118 East 28 Street, New York, NY 10016.

PLANS AND KITS

AMAZING ELECTRONIC PRODUCTS

LASERS SUPER POWERED, RIFLE, PISTOL, POCKET — SEE IN DARK — PYRO-TECHNICAL DE-BUGGING — UNCRAMBLERS — GIANT TESLA — STUNWAND — TV DISRUPTER — ENERGY PRODUCING, SCIENTIFIC DETECTION, ELECTRIFYING, CHEMICAL, ULTRASONIC, CB, AERO, AUTO AND MECH. DEVICES, HUNDREDS MORE — ALL NEW PLUS INFO UNLTD PARTS SERVICE.

INFORMATION unlimited
Box 626 Lord Jeffrey PZ, Amherst, N.H. 03031

FREE KIT Catalog contains Test and Experimenters Equipment. Dage Scientific Instruments, Box 1054P, Livermore, CA 94550.

CONVERT TV TO

NEW! 6 FT. WIDE SCREEN!

Easy Do-It-Yourself Kit

Project a giant 5'x6' picture onto wall or screen. B&W/Color. Kit contains detailed plans, Inst. and Precision Lens System. Only \$15.95 p.p.d., or write for Free illustrated details.

The Macrocoma Co., Dept. DC
Washington Crossing, PA 18977

FREQUENCY COUNTER, 300 MHz, miniportable/mobile, 7 digit .4" LED display, dual timing, memory. Construction plans: \$3.00. Kits available. PANAXIS, Box 5516-AK, Walnut Creek, CA 94596.

TESLA COIL — 40" SPARKS! Plans \$7.50. Information 75 cents. Huntington Electronics, Box 2009-P, Huntington, Conn. 06484.

ILLUSTRATED MANUAL, tells how to make an electric chess board that can play you in a game of chess! Simple materials for the device cost less than \$15! Manual also tells how to make an electric checker board that can play checkers! Send check or money order for \$10 to: Gary J. Van Braght, P.O. Box 26062, Lansing, Michigan 48909. Very little knowledge of electricity required to make either device! Not obtainable elsewhere.

THE "KING OF KITS". Artisan Organ Kits feature all new modular construction, with logic-controlled stops and RAM Preset Memory System. Write for brochure to: AOK Manufacturing, Inc., P.O. Box 445, Kenmore, WA 98028.

NEGATIVE ION Generator. Construction Plans, \$10.00. Kit, \$165.00. (Information—\$1.00). Golden Enterprises, Box 1282-PE, Glendale, Arizona 85311.

MIXERS—Preamps—Speakers, Top Quality Kits—Plans—Parts. Send 25 cents for catalog. Audio Design & Engineering Co., P.O. Box 154, Lee, Mass. 01238. (413) 243-1333.

**TIGER SST
SIMPLI-KIT**

**FOR
THE DO-IT-YOURSELF
NOW!** a high quality CD Electronic Ignition System in kit form.

Contains all components and solder to build complete Solid-State Electronic CD Ignition System for your car. Assembly requires less than 3 hours.

- Increases MPG 15%
- Increases horsepower 15%
- Eliminates 4 of 5 tune-ups
- Instant starting, any weather
- Plugs and Points last 50,000 miles
- Dual system switch

Fits only 12 volt neg. ground... Only \$21.95 postpaid

3-Star Corporation
P.O. Box 1727 Grand Junction, Colorado 81501

HIGH FIDELITY

DIAMOND NEEDLES and Stereo Cartridges at Discount prices for Shure, Pickering, Stanton, Empire, Grado and ADC. Send for free catalog. LYLE CARTRIDGES, Dept. P, Box 69, Kensington Station, Brooklyn, New York 11218. For Fast Service call Toll Free 800-221-0906.

BURGLAR ALARMS

Burglar . Smoke Fire Alarm Catalog

• Billions of dollars lost annually due to lack of protective warning alarms.

FREE CATALOG Shows you how to protect your home, business and person. Wholesale prices. Do-it-yourself. Free engineering service.



Burdex Security Co.

Box 82802 PE 117 Lincoln, Ne. 68501

EMERGENCY automatic telephone dialer, M-334. FCC registered. Free security catalog. S&S Systems, 5619A St. John, Kansas City, MO 64123. (816) 483-4612.

C.B.'s BECOME BURGLAR ALARMS with Modex Alarm Circuit. Plans \$1.99. Modex, Box 887, Middletown, Conn. 06457.

WANTED

GOLD, Silver, Platinum, Mercury wanted. Highest prices paid by refinery. Ores assayed. Free circular. Mercury Terminal, Norwood, MA 02062.

INSTRUCTION

LEARN ELECTRONIC ORGAN SERVICING at home all makes including transistor. Experimental kit—trouble-shooting. Accredited NHSC, Free Booklet. NILES BRYANT SCHOOL, 3631 Stockton, Dept. A, Sacramento, Calif. 95820.

SCORE high on F.C.C. Exams... Over 300 questions and answers. Covers 3rd, 2nd, 1st and even Radar. Third and Second Test, \$14.50; First Class Test, \$15.00. All tests, \$26.50. R.E.I., Inc., Box 806, Sarasota, Fla. 33577.

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, Ph.D's. Free revealing details. Counseling, Box 317-PE11, Tustin, California 92680.

SELF-STUDY CB RADIO REPAIR COURSE. THERE'S MONEY TO BE MADE REPAIRING CB RADIOS. This easy-to-learn course can prepare you for a career in electronics enabling you to earn as much as \$16.00 an hour in your spare time. For more information write: CB RADIO REPAIR COURSE, Dept. PE117, 531 N. Ann Arbor, Oklahoma City, Okla. 73127.

LEARN WHILE ASLEEP! HYPNOTIZE! Astonishing details, strange catalog free! Autosuggestion, Box 24-ZD, Olympia, Washington 98507.

GRANTHAM'S FCC LICENSE STUDY GUIDE — 377 pages, 1465 questions with answers/discussions — covering third, second, first radiotelephone examinations. \$13.45 postpaid. GSE, P.O. Box 25992, Los Angeles, California 90025.

INTENSIVE 5 week course for Broadcast Engineers. FCC First Class license. Student rooms at the school. Radio Engineering Inc., 61 N. Pineapple Ave., Sarasota, FL 33577 and 2402 Tidewater Trail, Fredericksburg, VA 22401.

1977 TESTS-ANSWERS for FCC First Class License. Plus "Self-Study Ability Test." Proven! \$9.95. Moneyback Guarantee. "FREE" BROCHURE. Command, Box 26348-P, San Francisco 94126.

GET your Commercial FCC License. New Exams by author of successful published workbooks of FCC Practice Tests. 500 Questions Second Class, \$11.95; 200 First Class, \$7.95; 100 Radar, \$4.95; Postpaid. Save, all three \$19.95. Complete mathematical solutions. Free counselling service. Victor Veley, P.O. Box 14, La Verne, Calif. 91750.

MICROCOMPUTERS—Learn microcomputer and microprocessing software and hardware fundamentals for hobby or career expansion. Send \$5.95 per book to: Computer Concepts, P.O. Box 641, Dept. 23A, Hackensack, N.J. 07602.

RADIO BROADCASTING: Become DJ, engineer, owner. Start your own station — receive free tapes, records. Learn Details Free. "Broadcasting", Box 5516-AK, Walnut Creek, CA 94596.

TUBES

RADIO & T.V. Tubes—36 cents each. Send for free Catalog. Cornell, 4213 University, San Diego, Calif. 92105.

TUBES receiving, factory boxed, low prices, free price list. Transletronic, Inc., 1365 39th Street, Brooklyn, N.Y. 11218A, Telephone: 212-633-2800.

TUBES: "Oldies", Latest. Supplies, components, schematics. Catalog Free (stamp appreciated). Steinmetz, 7519-PE Maplewood, Hammond, Ind. 46324.

TUBES antique, obsolete, new up to 55% off list, used from 29 cents with no minimum order. Send 25 cents for list of over 1,000 types. Connolly, Box 1333P, Sun Valley, Calif. 91352.

GOVERNMENT SURPLUS

MANUALS for Govt Surplus radios, test sets, scopes. List 50 cents (coin). Books, 7218 Roanne Drive, Washington, D.C. 20021.

GOVERNMENT SURPLUS. Buy in your Area. How, where. Send \$2.00. Surplus, 30177-PE Headquarters Building, Washington, D.C. 20014.

JEEPS—\$59.30! CARS—\$33.50! 200,000 ITEMS—GOVERNMENT SURPLUS—Most COMPREHENSIVE DIRECTORY AVAILABLE tells how, where to buy—YOUR AREA—\$2.00—MONEYBACK GUARANTEE—Government Information Services, Department GE-1, Box 99249, San Francisco, California 94109.

MAGNETS

MAGNETS. All types. Specials—20 disc, or 10 bar, or 2 stick or 8 assorted magnets, \$1.00. Magnets, Box 192-H Randallstown, Maryland 21133.

RECORDS

INDIRECT DISCS with Burwen fidelity. DICK WELLSTOOD — Jazz Piano, PETTY TRIO — Dance. \$15 each. DECIBEL RECORDS, Dept. 6, P.O. Box 631, Lexington, Mass. 02173.

MUSICAL INSTRUMENTS

UP TO 60% DISCOUNT. Name brand instruments catalog. Freeport Music, 114 G. Mahan St., W. Babylon, N.Y. 11704.

TAPE AND RECORDERS

RENT 4-Track open reel tapes—free brochure. Stereo-Par-ti, P.O. Box 7, Fulton, CA 95401.

8-TRACK and CASSETTE BELTS — money back guarantee. Long wearing. Free Catalog — \$3 minimum order. PRB Corp., Box 176, Whitewater, Wisconsin 53190.

VIDEO TAPE, Brand new. 1/2 inch, \$10.50/hour. Free information. Oregon Magnetics, P.O. Box 13374P, Portland, OR 97213.

RECORDS—TAPES! Discounts to 73%; all labels; no purchase obligations; newsletter; discount dividend certificates; 100% guarantees. Free details. Discount Music Club, 650 Main St., Dept 5-1177, New Rochelle, New York, N.Y. 10801.

BUSINESS OPPORTUNITIES

I MADE \$40,000.00 Year by Mailorder! Helped others make money! Free Proof. Torrey, Box 318-NN, Ypsilanti, Michigan 48197.

FREE CATALOGS. Repair air conditioning, refrigeration. Tools, supplies, full instructions. Doolin, 2016 Canton, Dallas, Texas 75201.

MAILORDER MILLIONAIRE helps beginners make \$500 weekly. Free report reveals secret plan! Executive (1K11), 333 North Michigan, Chicago 60601.

GET RICH with Secret Law that smashes debts and brings you \$500 to \$5 Million cash. Free report! Credit 4K11, 333 North Michigan, Chicago 60601.

HIGHLY PROFITABLE ONE-MAN ELECTRONIC FACTORY

Investment unnecessary, knowledge not required, sales handled by professionals. Postcard brings facts about this unusual opportunity. Write today! Barta-AN, Box 248, Walnut Creek, CA 94597.

HOW TO MAKE \$2,000 WEEKLY at home using other people's money. Guaranteed. Free Details. Richlieu, Box 25357, Dept. F8, Houston 77005.

NEW LUXURY Car Without Cost. Free Details! Codex-ZZ, Box 6073, Toledo, Ohio 43614.

MECHANICALLY INCLINED individuals desiring ownership of Small Electronics Manufacturing Business — without investment. Write: Marks, 92-K9 Brighton 11th, Brooklyn, New York 11235.

\$500 PER DAY POSSIBLE. New C.B. related business. Send 25 cents. P.A. Schubert Company, P.O. Box 187, Howell, Mich. 48843.

\$500.00 WEEKLY! IMMEDIATE Home income stuffing envelopes. FREE Supplies! Guaranteed! Send 25 cents, Stamp. ALCO, B19110-PEN, Las Vegas, NV 89119.

\$500/1000 IMMEDIATELY, stuffing envelopes, free supplies, rush stamped self-addressed envelope. Robert Drake Company, 1256 Bergen St., Brooklyn, N.Y. 11213.

EARN \$1,000 MONTHLY

Work one hour daily in the privacy of your home and in your spare time. "GUARANTEED," "FREE DETAILS" write: UNICORN, ZE11 7350 NUGGET COURT, COLORADO SPRINGS, COLO. 80911.

FREE REPORT: Big Money In Mail! Transworld-9K, Box 6228, Toledo, Ohio 43614.

GET RICH!!! Secret law erases debts. Free report exposes millionaire's secrets. Blueprints, No. EE11 453 W. 256, NYC 10471.

EARN IMMEDIATELY Stuffing Envelopes. \$300.00 thousand possible. Free supplies. Send stamped envelope. Salomon Industries-PE2, 6059 W. 55th St., Chicago, IL 60638.

\$3,000.00 MONTHLY. Immediate income. Stuff envelopes at home. Information, send self-addressed stamped envelope. Cottage, Box 730-HGK, Baldwin Park, CA 91706.

EMPLOYMENT OPPORTUNITIES

ELECTRONICS/AVIONICS EMPLOYMENT OPPORTUNITIES. Report on jobs now open. Details FREE. Aviation Employment Information Service, Box 240E, Northport, New York 11768.

DO-IT-YOURSELF

MODULAR TELEPHONES now available. Sets and components, compatible with Western Electric concept. Catalog 50 cents. Box 1147W, San Diego, California 92112.

TAPE-SLIDE SYNCHRONIZER, lap-dissolve, multiprojector audiovisual plans \$8.50. Free Catalog. Millers, 1896 Maywood, South Euclid, OH 44121.

MAKE PROFESSIONAL QUALITY PC boards with silk-screen techniques. Complete information, \$4.95 postpaid. TerraTronic Research, Box 513SP, Quincy, Ill. 62301.

REAL ESTATE

BIG...FREE...CATALOG! Over 2,500 top values coast to coast! UNITED FARM AGENCY, 612-EP, West 47th, Kansas City, MO 64112.

PERSONALS

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free. Hermes-Verlag, Box 110660/Z, D-1000 Berlin 11, Germany.

INVENTIONS WANTED

INVENTORS RECOGNITION...FINANCIAL REWARD...OR CREDIT FOR "INVENTING IT FIRST" MAY BE YOURS!

If you have an idea for a new product, or a way to make an old product better, contact us, "the idea people." We'll develop your idea, introduce it to industry, negotiate for cash sale or royalty licensing.

Write now without cost or obligation for free information. Fees are charged only for contracted services. So send for your FREE "Inventor's Kit." It has important Marketing Information, a special "Invention Record Form" and a Directory of 1001 Corporations Seeking New Products.

RAYMOND LEE ORGANIZATION
230 Park Avenue North, New York, NY 10017

At no cost or obligation, please rush my FREE "Inventor's Kit No. A-112"

Name _____

Address _____

City _____ State _____ Zip _____

Phone No. _____ Area Code _____

FREE PAMPHLET: "Tips on Marketing Your Invention", from an experienced fee-based invention service company. Write: United States Inventors Service Company, Dept. T, 1435 G Street NW, Washington DC 20005.

RUBBER STAMPS

RUBBER STAMPS, BUSINESS CARDS. Many new products. Catalog. Jackson's, Dept. K, Brownsville Rd., Mt. Vernon, Ill. 62864.

BOOKS AND MAGAZINES

FREE book prophet Elijah coming before Christ. Wonderful bible evidence. Megiddo Mission, Dept. 64, 481 Thurston Rd., Rochester, N.Y. 14619.

TECHNICAL MANUALS — Ameco, Arri, Cowan, Gilfer, Rider, RCA Radio Callbook, Sams, Tab, T.I. Postage 35 cents bk, ppd. Five. Madison Electronics, 1508 McKinney, Houston, Texas 77002.

HYPNOTISM

SLEEP learning. Hypnotic method. 92% effective. Details free. ASR Foundation, Box 23429EG, Fort Lauderdale, Florida 33307.

FREE Hypnotism. Self-Hypnosis. Sleep Learning Catalog! Drawer H400, Ruidoso, New Mexico 88345.

AMAZING self-hypnosis record releases fantastic mental power. Instant results! Free trial. Write: Forum (AA11), 333 North Michigan, Chicago 60601.

HOME ENTERTAINMENT FILMS

XMAS SHOP EARLY! You save \$2.00 + postage...order Super Bowl VIII (Dolphins/Vikings), Super 8 Color, \$17.95 ea. Marciano/Walcott, 2 Super 8 B&W reels, \$16.00 set. All/Frazier II, 2 reels Standard 8 Color, \$25.95 PPD (\$14.00 off). "Wheels Keep Rolling" 1976 Indy "500" film, Super 8 Color, 200' reel, \$19.95 ea PPD. Make selections from Columbia catalog, \$0.85; Universal 8 catalog, \$0.75; Sportlite forms, \$0.35. 10% off to catalog buyers on purchases of \$50.00. SPORTLITE, Elect-11, 20 N. Wacker Drive, Chicago, IL 60606.

MISCELLANEOUS

MPG INCREASED! Bypass Pollution Devices easily. REVERSIBLY!! Free details—Posco GEE11, 453 W. 256, NYC 10471.

CLASSIFIED ADVERTISING ORDER FORM

1	2	3
4	5	6
7	8	9
10	11	12
13	14	15
16	17	18
19	20	21
22	23	24
25	26	27
28	29	30
31	32	33
34	35	36

Please refer to heading on first page of this section for complete data concerning terms, frequency discounts, closing dates, etc. WORD COUNT: 15 WORD MINIMUM. Include name and address. Name of city (Des Moines) or of state (New York) counts as one word each. Zip Code not counted. Count each abbreviation, initial, single figure or group of figures or letters as a word. Symbols such as 35mm, COD, PO, AC, etc., count as one word. Hyphenated words count as two words. Telephone numbers count as one word.

Words

\$2.25 (Commercial Rate)
\$3.35 (Expand-Ad Rate)
\$1.35 (Personal Rate)

☐ Payment of \$ _____ enclosed for _____ insertions.

☐ AmEx ☐ BAC
☐ MC ☐ Diners

CHARGE: for _____ insertions.
You will be billed monthly.

Account # _____ Expiration Date _____

Master Charge Interbank # (4 digits above name) _____
SIGNATURE MUST BE PROVIDED BELOW

PRINT NAME _____

ADDRESS _____

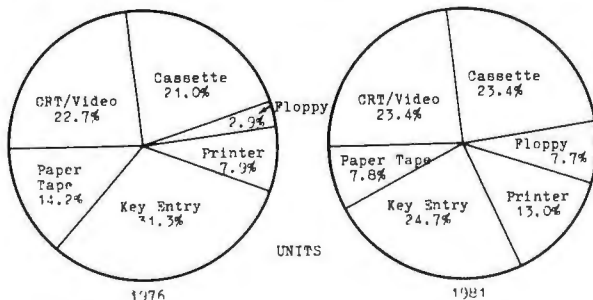
CITY _____ STATE _____ ZIP _____

SIGNATURE _____ PE-1177

news HIGHLIGHTS

Home Computer Sales Forecasts

A recent study compiled by the Venture Development Corp., Wellesley, Mass., reveals that purchases of computers and related products for home use will increase at an average 37% annual rate for the period 1976-1981. The study, "The Home Computer," cites that software



will represent the fastest growing submarket of the hobby computer industry, averaging 81% growth through 1981. Among peripherals, the floppy disk is expected to exhibit the fastest growth, rising 63% annually in units sold. Cassettes, CRT/video and printer sales are also expected to rise substantially. Computer stores will account for 61.6% of hobby computer sales in 1977, according to VDC's analysis, increasing at an average 47.8% annually in units.

New-Fangled IC's

Small, compact integrated circuits that can be clipped off a roll of film is the new style of IC being introduced by Siemens. The familiar beetle-like DIP, unmistakable shape of the IC, now has a challenger. The new production process involves mounting the silicon chips in the "windows" of polyimide ribbon similar to "super 8" motion picture film, with a potential of 1000 IC's per roll. Before the chips are mounted, the film surface is coated with copper, tinned and etched to produce conductors and terminal points. The inner ends of the conductors protrude into the "windows" of the film to provide both physical support and electronic binding. Known as the "Micropack System," the new circuits are expected to be used in compact units such as film cameras and flat desk-top computers.

Protection for Sensitive Equipment

General Electric's Tube Products Department introduced a self-contained plug-in Voltage Spike Protector, Model GESP-752. The device, not to be confused with a lightning arrester, is designed to protect TV receivers, stereo equipment and other sensitive electronic equipment from brief high-voltage surges from lightning strikes near power lines or switching "off" and "on" of major appliances. The GESP-752 plugs into a 120-V

grounded receptacle and acts like a safety valve, absorbing transients before they reach the equipment. It does not interfere with normal circuit flow nor add to energy cost.

RCA Pledges Free TV Labor . . . If

RCA has a new consumer program to assure customer satisfaction with television set repairs. According to a company spokesman, if RCA has made a date to visit a customer's home and fails to keep the appointment, the customer will pay no labor charge. The same promise of free labor if a service appointment is broken is also being offered to RCA's Whirlpool customers.

Energy Fair 1977

"Energy Fair 1977" is scheduled for November 3-6 at the Anaheim Convention Center, Anaheim, CA. The show will highlight alternative energies, and energy conservation techniques and products with the intention of bringing industry, science and the public together for meaningful communication and a positive approach to the energy problem. Features of the fair will be an Energy Career Center with a job-opening section, a slide show, a children's exhibition area, leisure parks, an energy literature information center, and a do-it-yourself area with energy-conservation and alternative-energy booths.

LCD Is Victor Over LED in Watches

If you've noticed that there are fewer watches on the market with LED readouts and more with LCD's these days, you were right. Ashley-Butler, Inc., which makes LCD readouts and various timekeeping devices using them, says that a recent watch industry projection showed that 56 percent of the approximately 15-million digital watches produced in the U. S. this year will have liquid crystal readouts. It is believed that the preference for LCD's is partly due to the availability of new inexpensive and efficient decoder-drivers. The new circuits provide a capability of driving digits from 2 inches to over 6 inches and makes LCD's practicable for what are expected to be broader applications.

Radio Prospects by 1985

Notes from a study, "Radio in 1985," made for the National Association of Broadcasters: FM will attract 51.7% of the radio audience due to the increase in quadraphonic broadcasting and a reduction in FM signal reception problems. . . . AM stereo may be ready to provide competition by 1980. . . . There will be 560-million radio sets of 2.4 per person compared to 401.6 million today. . . . The government may require all radiosets to be AM/FM. . . . CB is not expected to have a major impact on radio. . . . Satellites will be used increasingly for interconnection of stations or networking, yielding better audio quality. . . . The darkest cloud on radio's horizon is proliferating cable systems carrying radio as well as television.

ATTENTION DEALERS: *Announcing*

Jim-pak[®] **electronic components**

One-Stop Component Center

- *Over 200 quality items including integrated circuits, resistors, diodes, transistors, capacitors, connectors, switches, sockets, LEDs and Data Books covering all JIM-PAK[®] items.
- *Immediate delivery on all orders
- *Store display racks available
- *Stock rotation and return policy
- *Direct mail program available from list of active electronic buyers in dealers' area.
- *National advertising campaign in leading electronics magazines to include list of qualifying dealers
- *Nationally known manufacturers' products at prices every dealer can afford
- *Guaranteed products
- *Standard industry part numbers



A component line of proven sellers developed for the independent dealer. Ideal for computer shops, school stores, electronic dealers, hobby shops, or any location where there is a potential market for electronic sales.

A product line which supplies most of your needs from one distributor with a reputation for fast and efficient service. Attractive and compact display racks make initial installation of the JIM-PAK[®] line easy.

Your customers deserve the best. Now you can profitably retail name brand components at competitive prices. Be the first in your area to announce and sell the JIM-PAK[®] line. Write or call today.



FOR MORE INFORMATION AND PRICING SCHEDULE CONTACT:

, a division of James Electronics, 1021 Howard Avenue, San Carlos, California 94070, (415) 592-8097

The Touch by Regency is the first fully synthesized, 16 channel scanner to put over 15,000 radio frequencies at the command of a fingertip.

But even with its vast range of action frequencies, The Touch never allows you to miss a call on your favorite channel.

Because The Touch lets you set up Channel 1 as priority receiver. And it samples that frequency every 1.5 seconds.

Another point: The Touch can bring you severe weather warnings. Automatically. Simply

set Channel 16 to the National Weather Service alert mode, if available in your area. The Touch will cut into any severe weather broadcast.

In other words, it can override a thrilling fire to bring you news of a frightening tornado.

What else can you do with The Touch?

You can scan for action on your 16 favorite stored frequencies by merely touching SC. Or search for the unknown by pressing SS. And let The

Touch seek out frequencies you probably never knew existed.

And when you find new action, The Touch tells you exactly what you've found in the LED display.

The Touch by Regency. No complicated programming to do. No crystals to buy. It's the new soft touch in scanning.

Your Regency dealer has the details.

**The Touch by Regency.
The Ultimate Scanner.**



**You're never more than
1.5 seconds away from
your favorite frequency.**